ROADS AND STREETS

Design, Construction, Maintenance and Traffic Control

H. P. GILLETTE, *Editor*

Typical of Old Bridges Taken Over by Virginia State Highway Commission

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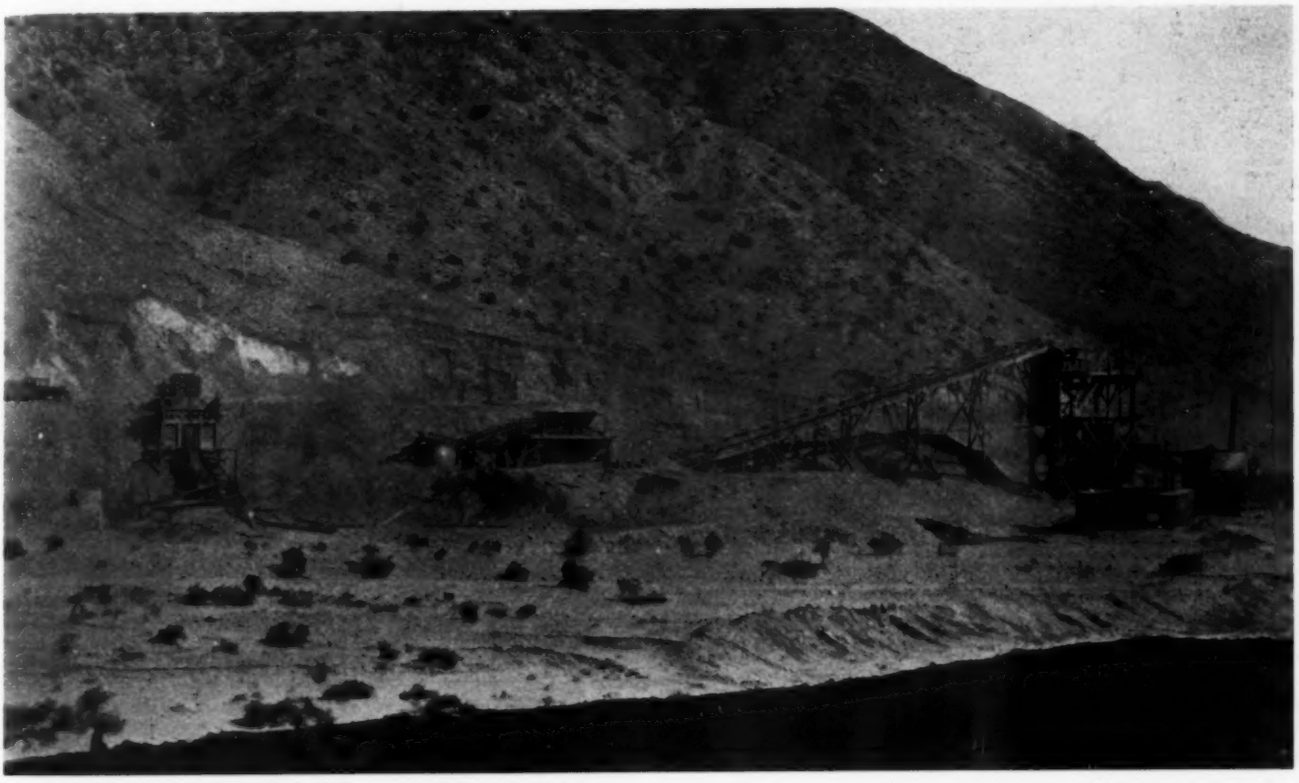


General View of Set-Up, Showing Crushers and Mixing Plant

Production Cost Studies
on the Owens Valley Highway

By R. W. EDWARDS *and* N. L. JAMES
Junior Highway Engineers, U. S. Bureau of Public Roads

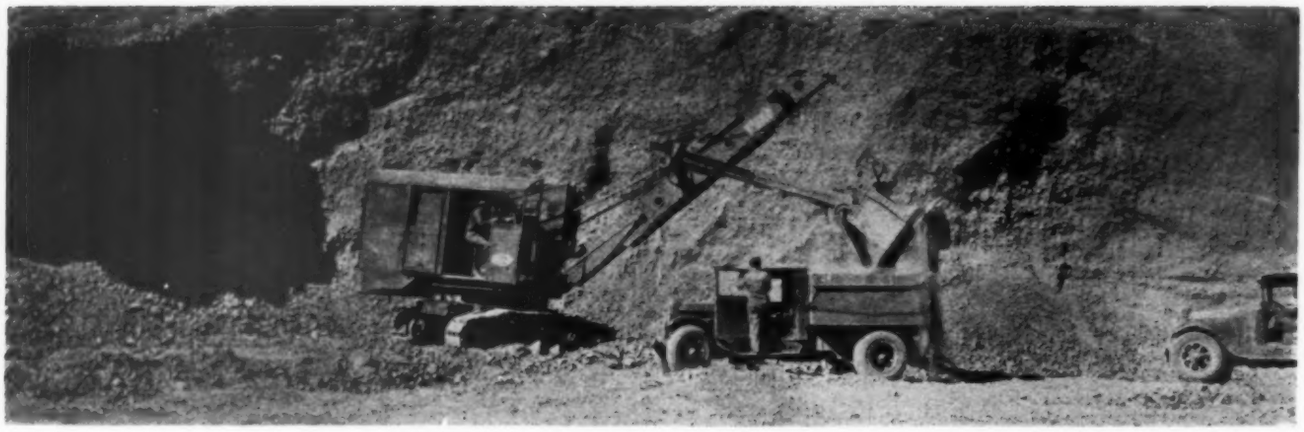
CALIFORNIA federal-aid project 187-E involved the grading and paving of 14.98 miles of highway northeast of Mojave, Calif., from Cinco to 7 miles north of Ricardo. This affords the most direct route of travel from southern California to points in the vicinity of Owens Lake, Mono Lake, Lake Tahoe and western Nevada. It also provides a means for reaching the eastern gateway to Yosemite National Park.

The principal items of this project involved the grading of about 9.3 miles of new alignment containing about 250,000 cu. yd. of roadway excavation, and the surfacing of about 15 miles of highway, 20 ft. in width, with a 3½-in. waterbound crusher-run base, and a 2½-in. plant oil-mix surface. A seal or skin coat was later applied to this surface course.

Although no traffic count or survey was made during the period of the production study, it is estimated that the number of vehicles traveling this highway is considerably less than 500 per day except during the summer months.

This article, descriptive of a 15-mile California oil-mix job, covers what has probably been the most efficient contract to date, especially from a production standpoint

The country which this section of the highway traverses lies along the western edge of the Mojave Desert just east of the Tehachapi Mountains, where the annual rainfall is less than 7 in. The soil is almost entirely a rather coarse desert sand of disintegrated granite or other similar material which drains excellently but which is



Excavating Surfacing Material

rather unstable due to the absence of clay or binder material.

Production Cost Study.—A production cost study was conducted on this project by the Division of Management of the Bureau of Public Roads during the period from Nov. 6 to Dec. 5, 1930. This was one of a number of similar studies being conducted throughout the United States for the purpose of reducing unit-costs and studying all types of highway construction. Systematic stop-watch studies were conducted each day on the key and auxiliary pieces of equipment and the contractor was immediately advised as to the exact causes and amounts of all delays. Suggestions were also offered as to how these might be reduced.

This project was entirely self-producing except for the fuel oil. All coarse and fine aggregates were excavated, crushed, delivered to the mixing plant and hauled to the grade by the contractor's own organization.

Contract Items.—While the chief items of the contract were the grading, the crusher-run base and the oil mix surface, there were a number of other units, the most important of which, together with the prices received, are included here:

Items	Quantity	Unit Price	Total Price
Roadway excavation, No. 1, cu. yd.	174,000	$0.37	$64,380
Roadway excavation, No. 2, cu. yd.	71,528	0.55	37,340
Overhaul, station-yards	608,000	0.02	12,160
Structural excavation, cu. yd.	2,400	0.80	1,920
Rock backfill, cu. yd.	690	1.50	1,035
Binder for subgrade, cu. yd.	11,500	0.58	6,670
Crusher-run base, tons	33,400	1.55	51,770
Oil mix, tons	24,600	1.83	45,018
Screening for seal coat, tons	900	2.40	2,160
Fuel oil for seal coat, bbl.	700	2.40	1,680
Water for subgrade and base, m. gal.	4,300	1.90	8,170
Total			$232,303

Close-Up View of Plant, Showing Screens, Bins and Mixer

The total value of the contract was $249,384.48.

Chronological History.—The contract for this project, as approved by the state, was formally awarded to George Herz & Co., of San Bernardino, on March 1, 1930.

Grading operations were started on March 7 and the erection of the crushing and mixing plant was started on June 9. By Aug. 14 the plant erection was complete, and the grading was sufficiently advanced so as to permit the construction of the crusher-run waterbound base to begin. After a two weeks' run of base, the oil-mix surfacing was started on Aug. 28. This method of alternating between base and surface was then followed for the remainder of the job. Surface and base construction was completed on Nov. 26. Application of the seal coat was started on Nov. 30 and completed on Dec. 4, on which date paving operations were completed.

View of "Slurry" Base and 2,700-Gal. Truck

Work on the culverts and concrete overflow dips was started about July 15 and proceeded without interfering with the base or surface construction.

Production Obtained.—During the period from Aug. 14 to Nov. 26, 48 days were employed for base construction and 42 days for surface construction. The average daily production on base for the total of 33,402 tons was 696 tons and the average on surface for the

total ot 24,598 tons was 584 tons. An 8-hour day was rigidly adhered to in both instances.

Organization and Personnel.—The contractor's organization, equipment and personnel are submitted in tabular form for both base and surface courses. The personnel and equipment varied but slightly for each course, the normal personnel averaging about 39 men. The total value of all equipment employed on the job is estimated at about $130,000.

Mr. Fred Herz, of George Herz & Co., was general superintendent and had complete charge of the entire job, while Mr. Kimble, plant superintendent, was in charge of the production of the aggregate and the operation of the mixing plant. Operations on the grade were directed by a grade foreman.

Sources of Materials.—Fuel oil of 60-70 penetration was purchased from the Standard Oil Co. of California at Seguro, Calif., and was shipped by rail a distance

Truck Dumping Plant-Mixed Oil Surfacing on Base

of about 70 miles to Mojave, from which point it was hauled to the plant by truck, a distance of about 25 miles.

Aggregate was obtained from local quarries and was excavated, crushed and screened by the contractor's organization. The haul for the aggregate from the quarry pit to the plant was less than a quarter of a mile, for which three trucks were employed.

Water obtained from a stream in Red Rock Canyon was used for all purposes except camp use.

Plant Location and Set-Up.—The crushing and mixing plant was located at the entrance to Red Rock Canyon, 6.5 miles from the southern end of the project and 8.5 miles from the northern end. There was practically no dead haul.

The crushing plant consisted of a feeding hopper at the primary crusher, a 15 x 36 Wheeling primary crusher, two 9 x 36 Wheeling secondary crushers, a scalping screen at the secondary and conveyor belts from primary to secondary and from secondary to the screens over the plant storage bins.

The mixing plant consisted of a wooden home-made type of batching and mixing plant. This plant was equipped with dual revolving screens which screened the aggregate into two sizes, plus or minus No. 3 screen. Each of the two storage bins had a capacity of about 40 cu. yd. A 3,000-lb. Standard pug-mill mixer with blades set at 45 deg. and revolving at 72 r.p.m. was used to mix both base and surface courses. All equipment, including crushers, belts, screens and mixer, was powered by gasoline motors. A 35-hp. steam boiler

Spreading the Oil-Mix Surfacing

was used to furnish steam to heat the fuel oil and to operate the discharge gate on the mixer.

The crushing and mixing plant had been previously situated at Barstow, Calif., and was hauled to this job by trucks over a distance of about 100 miles. The actual set-up of the entire organization during the period of the studies is shown in more detail in Tables II and III.

Construction of Crusher-Run Base.—The crusher-run base, as placed upon a carefully watered and rolled subgrade, consisted of a 3½-in. compacted course of material varying in size from 2½ in. to dust, with approximately 30 per cent passing the No. 3 screen.

Material for this base course was excavated at the quarry by a 1½-cu. yd. P & H shovel and hauled in trucks to the crushing plant where it was crushed to a maximum size of 2½ in. The material was then elevated by a conveyor belt to the mixing-plant screens where it was screened into two bins containing plus or minus No. 3 material. From these storage bins each size of material was batched in a weigh-box suspended on a dial scale and dumped into the pug-mill mixer by the mixer operator. Water, averaging about 3½ per cent of the weight of the dry aggregate, was weighed in a container suspended on another dial scale and was admitted to the mixer by the mixer operator almost simultaneously with the aggregate. The material was mixed for an average of 15.2 seconds and then discharged into a truck waiting under the mixer. Each truck hauled 5 batches. The charge consumed about 4 seconds, the mixing 15.2 seconds and the discharge 6 seconds, resulting in an average cycle of 25.2 seconds. During the period of the studies each batch weighed 2,500 lb. and the hourly production averaged 121 and 143 batches per hour operated and per hour utilized, respectively. This resulted in a production of 151 and 178 tons per hour, respectively.

The batches, after being weighed on platform scales by the state, were hauled to the grade and spread by the trucks so as to cover the subgrade with approximately 0.19 tons per sq. yd. Spreader boxes were not used. A Galion motor patrol was employed to spread the material, as dumped by the trucks, to an even compacted thickness of about 3½ in.

After the material was spread and bladed by the motor patrol, it was rolled by two three-wheel rollers, after which water was applied by a sprinkler truck at the rate of about 1.75 gal. per sq. yd. After the application of water, rolling was continued so as to bring

TABLE I — SUMMARY OF PRODUCTION AND TIME LOSSES

Items	Base Per Cent	Course Hours	Surface Per Cent	Course Hours
Hours Available	100.00	68.50	100.00	71.75
Major Delays				
Lack of materials	.....	.....	1.04	0.75
Truck supply	.....	.....	0.46	0.33
Repairs	1.58	1.08	1.39	1.00
Wind and rain	.....	.....	2.09	1.50
Change courses	1.09	0.75	.....	.....
Total Major Delays	2.67	1.83	4.98	3.58
Time Operated	97.33	66.67	95.02	68.17
Minor Delays				
Truck operation	0.42	0.29	0.00	0.00
Truck supply	4.26	2.92	4.18	3.00
Lack of rock	8.20	5.62	1.63	1.17
Operator	0.39	0.27	1.32	0.95
Miscellaneous	0.45	0.31	0.13	0.09
Power plant	0.57	0.39	0.00	0.00
Batcher trouble	0.45	0.31	0.00	0.00
Dump bins	0.00	0.00	0.70	0.50
Miscellaneous	1.62	1.12	0.19	0.14
Total All Minor Delays	16.36	11.23	8.15	5.85
Grand Total All Delays	19.03	13.06	13.13	9.43
Time Actually Utilized	80.97	55.44	82.87	62.32
Efficiency exclusive Unavoidable Delays	85.50	.....	95.40	.....
Efficiency inclusive Unavoidable Delays	80.97	.....	82.87	.....

	Batches	Tons	Batches	Tons
Production per Hour Available	118	147.2	66	99.6
Production per Hour Operated	121	151.1	69	104.8
Production per Hour Utilized	143	178.1	76	114.6

Operative Data	Seconds	Seconds
Charge	4	6
Mix	15.2	34.6
Discharge	6	7
Total Cycle	25.2	47.6

the fine material to the surface. This was known as "slush rolling." During all these operations the road was open to traffic, which resulted in the base being partially compacted by traffic. An interval of several days was always required between the time of completion of any section of base and the placing of the oil-mix surface over that section. This afforded an opportunity for the water to evaporate out of the base.

Construction of Plant Oil-Mix Surface.—The oil-mix surfacing, placed directly upon the base material, consisted of a 2½-in. compacted course of plant oil-mix material varying in size from ¾ in. to dust with approximately 70 per cent passing the No. 3 screen and about 7 to 8 per cent passing the No. 200 screen.

Aggregate for this course was excavated from the quarry by the P & H 1½-cu. yd. shovel and was hauled in trucks to the crushers, where it was crushed to a maximum size of ¾ in. Material leaving the crushers was elevated by conveyor belt to the plant screens where it was screened into the two storage bins in the same manner as with the base course. Fuel oil of 60-70 penetration, heated to about 175 deg., was admitted to the mixer by the mixer operator almost simultaneously with the aggregates. The oil added was about 4 per cent of the weight of the aggregate. The mixing cycle consumed about 47.4 seconds, of which 6 seconds was the charge and 7 seconds the discharge. Batches were discharged directly from the mixer into the trucks, no gob-box being used. Each truck hauled four batches. During the period of the studies the batches averaged 3,040 lb. each, and the production obtained was 69 batches per hour including minor delays and 76 batches per hour excluding minor delays. This resulted in 104.8 and 114.6 tons per hour, respectively.

The material, after being weighed by the state, was hauled to the grade and spread so as to cover the base with approximately 0.14 tons per sq. yd.

A Caterpillar 30 tractor and a 10-ft. blade were employed to spread this material to an even thickness of about 2½ in. when compacted. Spreader boxes and rollers were not used. A motor patrol was employed to maintain the runs of the two or three previous days. The road was open to traffic at all times, resulting in the material being entirely compacted by traffic at traffic speeds.

The method employed in laying the surface course was to start at the point nearest the plant and work away from the plant, thus causing the trucks to travel over the newly placed surface.

Seal Coat.—State specifications provided that a seal coat should be applied within three or four weeks after the completion of the surface course.

This seal coat consisted of 60-70 fuel oil and screenings applied at the rate of 1/6 gal. and 10 to 15 lb. per sq. yd., respectively. The specifications provided that all screenings should pass a No. 3 screen and that not more than 25 per cent should pass a No. 10 screen. The specifications further provided that the oil should be applied to a half-width of the road at a time and that the screenings after being spread should be broomed to an even thickness.

Material for this course was produced in precisely the same manner as that for the other courses except

TABLE II — WATERBOUND BASE EQUIPMENT, PERSONNEL AND ORGANIZATION

No.	Equipment	Size	Personnel	No.
	Producing and Crushing Materials			
1	P & H shovel	1½-yd.	operator	1
			oiler	1
3	Sterling trucks	5-yd.	chauffeurs	3
1	Primary crusher	15x38	laborers	2
2	Secondary crusher	9x36	laborer	1
1	Motor, Holt	120-hp.	laborer	1
1	Motor, Holt	75-hp.		
	Total			9
	Screening and Mixing Wet Materials			
1	Mixing plant	3000-lb.	foreman	1
			oiler	1
			fireman	1
			watchman	1
1	Motor, Climax	180-hp.	laborer	1
1	Motor, Waukesha	40-hp.	mixer operator	1
1	Plant truck	4-yd.	laborer	1
	Total			7
	Hauling to Road (Average Haul about 2.5 Miles)			
11	Reo trucks	5-yd.	chauffeurs	11
	Spreading, Watering, Rolling and Finishing			
1	Sterling tank truck		chauffeur	1
1	Packard tank truck		chauffeur	1
1	Motor patrol, 10-ft.		operator	1
1	Tractor, Best 30		operator	1
1	Blade grader, 10-ft.		operator	1
			dumpman	1
			laborers	3
			foremen	1
1	Roller, Galion, 12-ton		operator	1
1	Roller, Buffalo, 10-ton		operator	1
	Total			12
	Miscellaneous and Supervision			
			superintendent	1
			timekeeper	1
			mechanic	1
2	Ford runabouts			
1	Service truck		laborer	1
	Total			4
	Grand Total			43

TABLE III—PLANT OIL-MIX SURFACING EQUIPMENT, PERSONNEL AND ORGANIZATION

No.	Equipment	Size	Personnel	No.
	Producing and Crushing Materials			
1	P & H shovel	1½-yd.	operator	1
			oiler	1
3	Sterling trucks	5-yd.	chauffeurs	3
1	Primary crusher	15x38	laborers	2
2	Secondary crusher	9x36	laborers	1
1	Motor, Holt	120-hp.		
1	Motor, Holt	75-hp.	laborers	1
	Total			9
	Screening and Mixing Oiled Materials			
1	Mixing plant	3000-lb.	foreman	1
			oiler	1
			fireman	1
			watchman	1
1	Motor, Climax	180-hp.	laborer	1
1	Motor, Waukesha	40-hp.	mixer operator	1
1	Plant truck	4-yd.	laborer	1
	Total			7
	Hauling to Road (Average Haul about 2.5 Miles)			
8	Reo trucks	5-yd.	chauffeurs	8
	Spreading and Finishing			
1	Motor patrol	10-ft.	operator	1
1	Blade, Galion	10-ft.	operator	1
1	Tractor, Best 30		operator	1
			dumpman	1
			laborers	3
			foreman	1
	Total			8
	Miscellaneous and Supervision			
			superintendent	1
			timekeeper	1
			mechanic	1
2	Ford runabouts			
1	Service truck		laborer	1
	Total			4
	Grand Total			36

that there was no batching or mixing and the trucks were loaded out at the plant. Oil was hauled by a distributor truck from the plant to the grade and applied at about the specified rate. Trucks hauling screenings spread their contents over the oiled surface by regulating their tail gates and moving at a constant speed. A motor patrol with a broom attached to the blade was employed to broom the screenings to an even thickness. The production for this course averages about 214 tons or about 3 miles per day.

This seal coat was a relatively expensive item and, as far as could be observed, tended to roughen the surface somewhat and decrease rideability. It was quite difficult to apply the screenings exactly uniformly, and any failure in this respect resulted in a corrugated or scaly surface.

Factors Favoring or Limiting Production.—The factors limiting production on the base course were the crusher set-ups and the batching and mixing operations. There was no set mixing time and it was only required to mix the material long enough to produce an even mix. About 12 to 15 seconds usually sufficed. A minimum of about 25 seconds was required to batch the materials, and this set the limit for production.

When the crushers were properly regulated and when the material from the quarry was running uniformly there were very few delays due to lack of the proper size of materials and it is believed that under very favorable conditions this set-up could produce aggregate sufficient for about 1,600 tons per day. There were naturally some delays due to an excess or deficiency of either size or due to a failure to have the crushers adjusted properly. These could have been appreciably reduced by installing "feelers" and automatic overflow chutes in the bins. It is readily realized how difficult it is to feed aggregate to the crushers in the same proportions in which it is to be used in the mix, and some delays from this source are certainly unavoidable.

Failure to employ a gob-box or truck hopper also resulted in considerable delay and increased hauling costs.

In the case of the surface course the chief factor limiting production was the mixing time. This was largely controlled by the weather. During warm weather satisfactory mixing could be obtained in less than 60 per cent of the time required during cold weather when the air temperature approached 32 deg. Then the mixing time was as high as 45 and 50 seconds.

It is estimated that the crushers could supply at least 1,000 tons of surface-course material per day, which was the case on Nov. 25, when 1,001 tons were produced. However, the stop-watch studies indicate that under the average existing climatic conditions 920 tons is about the best that can be reasonably expected.

Time Losses.—The chief sources of time losses were lack of the proper size of material for the base course and lack of hauling equipment for the surface course. The actual time losses which occurred during the period of the studies are given in Table I.

Several suggestions were made to the contractor as to how he might secure higher production on future contracts. The chief of these were as follows:

1. Installation of a 5-batch gob-box.
2. Installation of feelers in the bins.
3. Installation of overflow chutes.
4. Installation of a timing device for the mixer.
5. Installation of a small dryer to heat the aggregate during cold weather.

Engineering Personnel.—Engineering and inspection for the state of California were conducted by Walter Matthews, resident engineer, assisted by James Abrams, street inspector, and Glen Ostrander, plant inspector.

Acknowledgment.—The writers sincerely wish to acknowledge the courtesies and cooperation received from Mr. Matthews, resident engineer, and Mr. Kimble, plant inspector.

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States Are Pushing Highway Plans to Use $80,000,000 Appropriation

State highway departments are rapidly availing themselves of the emergency appropriation of Dec. 20 providing $80,000,000 for use by the states in matching regular Federal-aid funds, the Bureau of Public Roads of the U. S. Department of Agriculture reports.

The eleven district offices of the bureau are now busily engaged in examining proposals for road construction which will involve the use of these funds. Projects recommended for approval are already reaching the headquarters of the bureau in Washington.

The first of these proposals came from Delaware one week after the emergency legislation was enacted. Construction programs have also been proposed by Florida, Maryland and Connecticut. It is anticipated that within the next few days many proposals will be pouring into the Washington office of the bureau.

▼

GAS TAX POPULAR IN FOREIGN COUNTRIES.—Reports submitted for the Sixth International Road Congress, Washington, Oct. 6-11, indicate that the gasoline tax during the past ten years has come into widespread use throughout the world.

More DAILY HAPPENINGS *on* Ordinary Road Jobs

By CHARLES T. FISHER
Engineer, Owen P. Williams Construction Co., Inc., Oneonta, N. Y.

CONSIDERABLE interest was manifested by readers of ROADS AND STREETS in the article, "Everyday Happenings on Ordinary Road Jobs," in the July, 1930, issue. Here, Mr. Fisher recounts some more occurrences that are "all in the day's work" of the road constructor.

WHENEVER a highway which is being improved or repaired has to be closed to traffic, the number of people who want to go over it increases overnight, and some of them are willing to do a lot of hard work taking down barricades to satisfy themselves that the warning signs really mean what they say. The most effective barricade we have tried is a mound of earth extending all the way across a cut or a fairly high fill (Fig. 1). Even the most curious decide to take the detour when such an obstruction appears.

Detour signs, unless they are placed on a real barricade, get little attention from the average motorist, but occasionally there are other signs along the highways which compel attention. Sidney Center asks your consideration in no uncertain manner (Fig. 2) and the farm sign shown in Fig. 3 is more noticeable because of its simplicity. Contractors' warnings are discounted regardless of their message (Fig. 4).

The use of 6-in. vitrified pipe for underdrains is common practice on New York highways, and a specially-built bucket, only 16 in. wide, was tried for digging the trenches (Fig. 5). By its use the size of the excavation was kept nearer the pay limits, and the danger of the shovel treads breaking down into the ditch greatly diminished.

Larger buckets are more useful for some work, however, as in Fig. 6, which shows an apple tree being carried to its final resting place at the bottom of a deep gully across the road.

When a bridge in Tioga County, N. Y., was rebuilt, a large number of short timber piles was found under the old abutment. They were in excellent condition, but of course they had to be pulled out to make room for new ones. This was done by placing a heavy timber A-frame under the end of the crane boom and applying a direct upward pull (Fig. 7). About 3,200 cu. yd. of concrete was to be placed in the abutments of the four bridges on this contract, so a complete paving plant was used, with a crane, batch bins, measuring hoppers, batch boxes, a very short industrial railway and a 21-E paver (Fig. 8 and 9). For part of the work batch trucks were used instead of the cars and batch boxes. The paver was placed where the concrete could be delivered directly into the forms. Figure 10 shows a closer view of the bins and batch box.

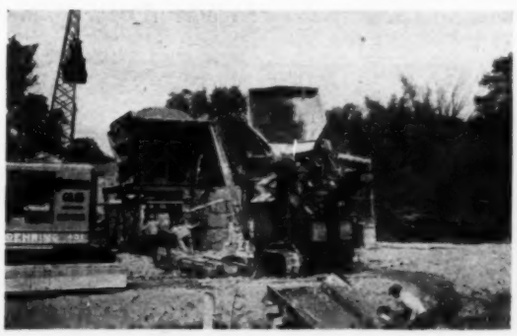
The use of so much plant was justified by the speed with which concrete could be poured, but speed was not always an advantage on this job, as one of the engineers discovered when he was hurrying home for lunch. His coupe refused to follow a curve which had just been laid out and made a set-up on the point of intersection (Fig. 11).

For the smaller concrete structures an easily portable rig was made by mounting a 3-bag mixer and a gasoline engine on a 7½-ton four-wheel trailer (Fig. 12). Steel forms (Fig. 13) made in sections which could be keyed together to build different heights and lengths were used with good success for concrete headwalls on pipe culverts.

At one point it was necessary to carry a small stream across the highway and at the same time under a railroad underpass, so that the cul-

Fig. 1 (left)—An Effective Barricade. Fig. 2 (above)—An Arresting Sign in Sidney Center. Fig. 3 (right)—The Simplicity of This Sign Makes It Noticeable

Fig. 4—(center)—An Emphatic Warning. Fig. 5 (left)—Trenching with a Specially-Built Bucket. Fig. 6 (right)—One Use for a Large Bucket



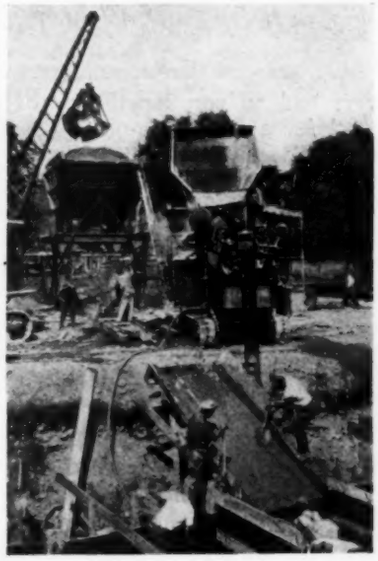


Fig. 7 (left)—Pulling Timber Piles with Crane and A-Frame. Fig. 8 (above), Fig. 9 (right)—Concrete Paving Plant Used in Placing Bridge Abutments

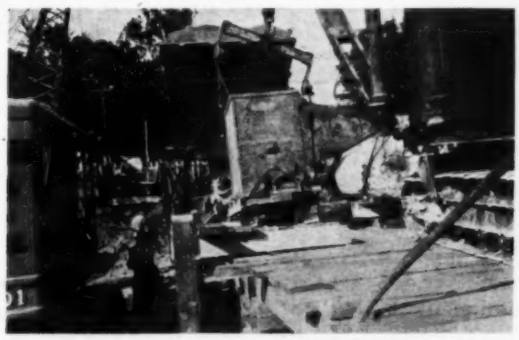


Fig. 10—Bins and Batch Box

Fig. 11 (left)—A Set-Up at the P. I. Fig. 12 (center)—Portable Rig for Smaller Concrete Structures. Fig. 13 (right)—Steel Forms for Concrete Culvert Headwalls

Fig. 14 (left)—An "Alemite" Double Box Culvert. Fig. 15 (below)—Cast-Iron Pipe Leading to Culvert. Fig. 16 (right)—The Improvised Roller Was a Failure

vert had to run lengthwise of the road for quite a distance. A rather unusual structure was built, of the type known locally as an "Alemite" culvert because of the difficulty in finding a way to get concrete into the forms after all the reinforcement is in place. This was a double 4x10-ft. box, 276 ft. long (Fig. 14), which had two banked curves built in near the lower end. A 36-in. cast-iron pipe (Fig. 15) was let into one side to catch any water which might miss the main entrance.

On another contract a bridge-approach fill was being made with gravelly soil from a borrow pit. The material was spread with a bulldozer and was being rolled in layers with a 10-ton roller until the roller broke down. As no pavement was to be placed on the fill until the following year it was thought that perhaps the work could be kept going by using a 4-yd. load of dirt on a truck for a roller (Fig. 16). It didn't work. Properly compacted fills are a primary requirement in modern road building, as a written order to shut down soon proved.

A civil service examination held many years ago was said to have contained the following question: "If it were impossible to buy erasers, give four reasons why the Barge Canal could never be built." Which leads us to wonder whether highway construction would have to stop if no more road rollers could be obtained.

Federal Construction Expenditures Show Increases for 1930

An increase in last year's outlay by the Federal government for roads and other permanent improvements over the expenditures for 1929, when $352,436,000 was spent, is predicted by Dr. Leo Wolman in the chapter on "Federal Construction" of his survey entitled "Planning and Control of Public Works," which has been made public by the Committee on Recent Economic Changes.

Pending governmental projects named in the chapter on "Federal Construction" include those pertaining to the inland waterway system, irrigation, maintenance of channels at ocean ports, grants for state highways, the 10-year program for post officers and Federal buildings, the lighthouse and Coast Guard service, roads through national parks and national forests, new quarters for Army posts, $15,000,000 worth of new hospitals for World War Veterans, penitentiaries, fish cultural stations, customs houses, immigration stations, Indian schools, the 900 or more land stations of the Navy, the Alaskan Railway, the Panama Canal, and the District of Columbia.

A decided shift in the nature of federal construction expenditures from 1919 to 1929 is noted by Dr. Wolman. Of a total expenditure in the fiscal year from July 1, 1918, to June 30, 1919, of $716,000,000, nearly $459,000,000 was used by the Navy Department and more than $200,000,000 by the Quartermaster Corps of the Army; in that year the Bureau of Public Roads of the U. S. Department of Agriculture spent only $3,750,000 on roads. By 1923 road building had become the leading item of federal expenditure, and has continued in first place since that time.

Road building outlays, Dr. Wolman points out, have risen from the low level of 1919 to an average of more than $90,000,000 annually since 1924. Actual expenditures both for forest roads and in the form of federal aid to states increased from nearly $25,000,000, in 1920 to $108,000,000 in 1925 and have continued above the $90,000,000 level since then. In this connection, it is noted that the Federal Aid appropriations for 1931, 1932, and 1933 have been increased by $50,000,000, that is, from $75,000,000 to $125,000,000 a year.

Dr. Wolman mentions that expenditures for maintenance and repairs on all kinds of construction during the past decade have amounted to somewhat less than 10 percent of the amount spent in new construction. The Navy estimates, he states, that repairs to ships require $10,000,000 annually.

The radical change in the procedure for making appropriations for federal construction that has taken place since the passing of the Budget Act of 1921 is emphasized by Dr. Wolman. The budget system, he explains, has led to a growing practice among federal departments to map out long-term programs.

A. R. B. A. Reports Indicate Trends in Highway Policy and Practice

COMMITTEE reports of the American Road Builders' Association, presented at the 28th annual convention of the association in St. Louis, Mo., Jan. 12-16, 1931, give a comprehensive picture of current trends in highway administration, finance, planning, construction and maintenance, and form a valuable background for outlining future progress in the development of the nation's system of highways and city streets. From the great mass of information and recommendations placed before the convention, that likely to be of most interest to the greatest number of readers of ROADS AND STREETS has been selected for inclusion in the summary which follows.

Highway Administration and Finance

One of the most important reports presented at the convention was that of the Committee on Highway Finance and Administration, of which T. H. Cutler, chief engineer, Missouri State Highway Commission, was chairman. In the foreword to the report the committee stated:

Future progress of highway development is dependent on sound financing. Where highway funds have been plentiful, satisfactory connecting systems have generally resulted. Coordinated expansion in general, however, does not now and has never existed due to lack of financing methods based on present and future traffic demands and the development of a continuous system.

Motor transportation ignores state, county, and township limitations, yet passable highways often terminate at boundary lines regardless of traffic requirements. Road systems should be chosen according to their order of importance, regardless of boundaries, and funds should be allocated to meet these requirements among states, counties, townships and cities.

Then state funds should be used on the primary system until that system is continuous, and highways connecting centers of population, even though carrying small traffic volume should be developed sufficiently to furnish necessary connections.

Engineering transportation surveys are the basic means for determining fund distribution. Unfortunately, even many of the better organized state departments do not carry on transportation surveys over the entire mileage and have little knowledge of present traffic requirements or means of forecasting future demands on other than state systems. Funds are, therefore, wasted in some instances by over development and in others by under estimating future requirements.

The demand for highway expansion will continue to increase and the degree of this expansion is predicated on the economic use of public funds. The basis of satisfactory distribution is budgeted expenditures allocated according to surveyed traffic demands, and by highway planning which permits the construction of connecting highways.

Conclusions and Recommendations.—The conclusions and recommendations of the committee are summarized as follows in the report:

1. The development of a master highway plan by the state embracing the entire mileage included in the state based on engineering transportation surveys and the development of a continuous system.
2. The highway administrative structure to be composed of but three operating units, state, county and city.
3. If state funds are allocated to counties and cities, the distribution to be based on transportation surveys. To be expended on through highways necessary for the completion of a connecting system.
4. The elimination of state highway financing by county aid.
5. The elimination of the use of gas tax funds and registration fees for other than highway purposes.
6. Simplification of present street and highway administration by consolidation wherever possible.
7. The elimination of highway districts operating and financing separately within counties.
8. The development of a plan of highway financing and administration which tends toward centralization of planning, which permits simplified financing which combines financial resources, which curtails unnecessary personnel, which permits budgeting, and which is dictated by existing conditions rather than by those existing a century ago.
9. A system which will ultimately result in connecting highways regardless of political boundaries.
10. State requirements to apply to county highway operation in a manner similar to the supervision exercised by the federal government in the state.
11. Gasoline taxes and license fees to be levied solely by one jurisdicttion—the state.
12. State bonding for highways has in every instance resulted in an investment.
13. Where highway development is in its early stages and urgent necessity exists for better highway transportation, then immediate relief can only be secured by the sale of bonds.
14. The use of current funds for highway construction is recommended where highway systems are mostly completed and where maintenance and reconstruction are the principal factors.
15. The primary system (state highways) should be financed by current funds or bonds, depending on degree of completion and transportation requirements.
16. The secondary system (county trunk highways) should be financed by state aid and local taxes or bonds.
17. Third class highways (purely local roads) should be financed by local taxes or county bonds.
18. In metropolitan areas which are carrying a large percentage of the total state traffic, relief measures on trunk highways should be given consideration by the state through regional planning bodies.

Highway Income—Bonds.—Bonding for the construction of state highways has resulted in a paying investment in every instance. Tangible savings from lowered cost of operation are in excess of construction and maintenance costs. Savings in operating costs to the motorists of Illinois have amounted to $333,000,000 which is considerably more than the cost of the highways and the interest and amortization charges on the $160,000,000 highway bond issue.

The life of the improvement should exceed the retirement period of the bond issue. Serial bonds are most economical, and for state use should be retired in a period not to exceed 30 years and for counties 20 years. Attempting to construct a large mileage of highways in a limited time by the use of annual tax returns only results in high tax levies and places a financial burden on the present tax payer which should be distributed over a period of years.

Thirty-four states impose a personal property tax on automobiles. Money derived from this source is placed in the general funds of state, county, or city and used for general purposes of government. These funds are not used for highway purposes.

Highway Administration.—Administration by central

and district offices is well conceived and is ideal if entirely controlled by the central office. Its strength lies in complete centralization, and any lack of cooperation between central office and districts results in conditions which are similar to those existing in the county district organization, each district operating as a state within itself.

Private business has benefited by centralized operation. Nation-wide corporations have cut operating expenses and simplified their administrative structures by consolidation. This should be true of highway administration and there is a necessity for reducing the number of highway jurisdictions.

There are approximately 3,000 counties in this country and many of these are divided into highway districts. There are 7,334 towns and cities of over 1,000 population and many of the cities are divided into highway districts. The total units administering highways in this country evidently approximates something in excess of 10,000.

Taxing jurisdictions are estimated at approximately 500,000 and while a small percentage of these are concerned with road building, this factor is important in view of the fact that credit is impaired by a great many different authorities obtaining funds from one source or locality.

Allocation of Highway Funds to Counties.—Forty states are now giving financial assistance to counties Many of the states act in a supervisory capacity; some furnish plans and specifications. The allotment of license fees and gas tax is becoming more popular.

Eight states share license fees with counties. Ten states share gas tax and seventeen states share both. One state pays interest and amortizes county bonds used in the construction of hard surfaced county roads, these being taken into the state system on completion. Several states are amortizing and paying interest on county bonds used on state construction. Counties receive assistance in a few instances from fund allotments from state appropriations.

Various methods of allocation by states to counties are listed as follows: (1) Consumption basis (cents per gallon of gas sold in each county). (2) Allotment on basis of proportion of county mileage to that of the state. (3) Percentage of license fees collected in each county. (4) Forty per cent distributed equally, sixty per cent in proportion to assessed valuation to that of the state. (5) Area and population. (6) Ratios of uncompleted mileage to total mileage. (7) Thirty dollars per mile for county mileage outside cities and towns. (8) Area and assessed valuation. Funds to be matched by county funds. (9) One-half equally to all counties, one-quarter in proportion to registration, and one-quarter in proportion to number of farms in each county.

It is evident that state distribution of funds to counties will continue to increase in the future as it has in the past. The extent of this increase is to a large extent dependent on economic expenditure.

At the present time the greater per cent of the traffic volume is on the state system and it is, therefore, evident that state funds should be expended on this system until it is at least passable.

Distribution of funds to counties would be a comparatively simple matter if knowledge of traffic requirements were available, and it is evident that this is necessary before a fair and equitable distribution will result.

Administration of State Funds in Counties.—Methods of controlling the use of state allotments to counties are varied.

One state supervises construction on high cost projects. Several states act in advisory capacity on request. Sixteen states exercise no supervision. Thirteen states supervise funds spent on state routes only. A list of practices existing follows: Engineering supervision and approval of plans. Engineering supervision, approval of plans, estimates and contracts. Preparation of plans and specifications. Engineering supervision of work on county trunk system only. Supervision on request at county expense. The furnishing of plans, specifications and supervision at county expense.

Funds for Townships.—Twenty-seven states report no township system. There are twelve states which give financial aid to townships, either in the form of a share of gas tax and registration fees or a flat rate per mile on state highways passing through the subdivision.

In some instances counties aid townships financially. There are few instances where township highways are a part and under the jurisdiction of the county organization.

It is evident from information available that in general there is little township highway activity, the construction and maintenance at present including only that done on state highways. There are few townships with adequate engineering organizations to operate successfully, financial resources are insufficient and the necessity for consolidation is obvious.

Effectiveness of Rural Highway Administration.—The U. S. Bureau of Public Roads recently made a survey of local highway administration in which the effectiveness of the various existing methods has been summarized.

The local rural mileage in the United States at present totals approximately 2,750,000 miles. One million miles of this is administered by town or township authorities, the remainder amounting to about 1,750,000 is administered by county authorities.

There are 3,066 counties or similar governmental subdivisions in the United States, 67 of which are in New England and have no significance as units of highway administration. One thousand seven hundred thirty-one or 57 per cent of the remaining 2,999 counties have some degree of engineering control of road construction or maintenance. In 1,115 of these, or 37 per cent of the total number, there is reasonably competent engineering control of highway construction and in 975 of these, or 32 per cent of the total, the control of road maintenance is reasonably competent. There are 829 counties in which there is no definite organization for road maintenance and the work is casual and inefficient.

In the mid-western area the rural highway system is generally divided into two classes, county and township, and in this group the county roads are administered by the county and the township roads by township authorities.

In most of the remaining states, including the south and southwest and coast and mountain groups, local roads are administered by county authorities and the township system has no significance.

With few exceptions the 1,000,000 miles under township jurisdiction is administered ineffectively and inefficiently.

Supervising Authority by States.—There are several states which exercise supervisory authority to a large degree over local highways.

Illinois is adopting a plan which should tend toward the improvement of local administrative units without

destroying the principles of home rule. The policy under consideration by the state should have the same effect on local engineering organizations as federal aid has had on the state.

At the present time the state highway department approves plans, estimates and contracts and furnishes general supervision on all county highway work.

All township work of $200 or more or equipment purchased in this amount or excess, requires approval of the county superintendent of highways. The township highway commissioner is a deputy of the county superintendent, who, in turn, is a deputy of the state department.

At the present time the state is organizing a bureau of county roads in order to extend to the counties the maximum amount of consulting service and to expedite the approval of plans and specifications. The latter will be compiled by the state, paying particular attention to the use of local materials, and other existing county conditions.

The bureau will function through a corps of engineers stationed in the present district offices who will be county-minded and by reason of years of experience will be able to cope with existing problems.

Many of the county organizations have competent engineering personnel, and while the employment of state engineers is not mandatory, the work of the counties must meet state requirements.

It is the duty of the Department of Public Works and Buildings to prescribe a system of auditing and accounting for all road and bridge funds for all counties. This precludes the possibility of using highway funds for other purposes.

Evidently Illinois is basing its highway construction on traffic requirements as work is now being accomplished in the metropolitan area surrounding Chicago by highway widening and grade separation. It is estimated that approximately one-third of the state highway program for the next few years will be carried on in this area, thus furnishing ultimately the necessary relief from congestion.

New Jersey, by reason of a recent legislative act, is making a study of rural road improvements through a commission appointed by the state.

At the present time they are consulting with each county engineer and county board of freeholders and laying out a system of roads in each county.

Township roads will be divided into three classes. The first class will include those which are important enough to be included in the county highway system. The second class will include important township highways which connect with state highways or county roads and which serve local municipalities or have schools or churches on them. The third class includes those of lesser importance and which do not form any through routes or connections with important county or state highways.

It is the purpose to have state aid apply to roads of the first class and after they are constructed to have them taken over by the county into the county highway system. On completion of this system, they will proceed with construction of highways of the second class and these will remain under the jurisdiction of the township. Third class township highways will be constructed and maintained entirely at the township's expense.

At the present time the state furnishes specifications and supervision on all state aid work in counties and townships and cooperates closely with all county and township work.

According to the present plan the more important township roads will ultimately become a part of the county system.

Trend Toward Centralized Administration.—The foregoing instances are cited as an indication of a trend toward coordination of highway administration in some states. There are excellent features embodied in the methods employed in these states.

The ultimate absorption of the greater portion of township highways by the counties as proposed in New Jersey is commendable. Iowa has progressed in this respect, by including the township highways in the county system.

The New Jersey practice makes possible in fact the development of a coordinated plan of improvement for the entire highway system, places state aid funds where the demands of traffic are the greatest and simplifies the allocation of these funds. The county as a road building unit does not lose its identity, but is strengthened by cooperating closely with the state.

Funds for City Streets.—There are 22 states at the present time in which funds are allocated for city streets from outside sources. In all but two instances these funds are allocated by the state. Atlanta, Ga., spent last year $160,000 allocated to the city by the county. Counties in California contributed $1,500,000 in 1929 for city street construction.

In most instances the state either builds the trunk highway according to the state standard width or else allocates funds for the construction, or a portion of the construction. Several cities receive an apportionment based on a flat rate per mile of state highways. Two states allocate funds to the largest city in the states without provision for other municipalities. First, second and third class cities in Missouri levy an additional one cent gas tax and additional license fees. Indiana allocates one-fourth of one per cent of all state receipts to cities on a property basis.

Allocation of Funds to Cities; Regional Planning.—Cities are benefited by highways in three ways. First, there is a general benefit accruing to the whole area by reason of stimulating growth and industry. Second, they are benefited by increasing values of urban and suburban property and third, the improvement results in more economical transportation.

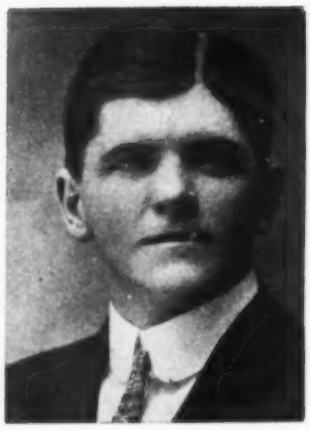
These various participants should evidently contribute toward city street improvement. The portion to be borne by the state constitutes a problem over which there is much controversy.

Trunk highways should be continuous through metropolitant areas. Wide highways should not terminate at the city boundary, and for this reason, the regional organization, which includes the entire area affected by traffic congestion is well fitted to cope with problems involving through highways in these areas and is necessary for the development of a master plan.

Traffic Volume.—Statistics showing percentage of traffic on various highway classifications are interesting. A survey made in several states by the U. S. Bureau of Public Roads indicates that from 75 to 90 per cent of vehicles operating on state highways are city owned. Therefore, it is evident that rural landowners should pay but a small percentage of the cost of these highways.

As an indication of conditions existing concerning traffic concentration points the following percentages are given for the purpose of showing that each state has individual problems to solve in allocating funds to meet traffic requirements. Twenty-six per cent of the vehicles registered in California are owned in Los Angeles. Thirty-one per cent of the vehicles registered

T. H. Cutler



R. Getty Browning

in Michigan are owned in Detroit. Thirty-three per cent of the vehicles in New York are owned in New York City. Chicago has 26 per cent of Illinois' total. Boston has 18 per cent of the registration in Massachusetts and Philadelphia has 17 per cent of registrations in Pennsylvania.

Highway Location

The report of this committee, of which R. Getty Browning, principal locating and claim engineer, North Carolina State Highway Commission, is chairman, was presented under the following sub-heads: classification and right-of-way, visibility, grade crossings, bridges and culverts, spur roads, distribution of construction costs, allowable grades and curves.

Classification and Right-of-Way.—A classification of highways based upon traffic is proposed, and a tabulation of standards for four such classes has been made. The problems connected with the securing of rights-of-way are recognized as being difficult and annoying. A policy of minimum standard right-of-way widths is now general among the states, and several states have adopted the plan of widening right-of-way at railroad crossings and road intersections. With regard to means of acquiring necessary rights-of-way, the following outline is recommended:

1. That the right-of-way be acquired by the state highway department, the county in which the right-of-way lies to be required to pay into the state road fund the necessary amount of money, to cover the purchase price, or certain taxes now accruing to the county be diverted to the state road fund to cover right-of-way costs.
2. That the value placed on each piece of property bear some direct relation to the assessed value.
3. That the state highway departments include as a bid item the removal of fences and obstructions from the limits of the right-of-way and the rebuilding of the fences from salvaged material, and the construction of a standard type of right-of-way fence where necessary. If the property owner desires a better type of fence than that constructd by the highway department, then the property owner may construct his own fence at his entire expense.
4. That the highway department provide suitable passage onto the new road for the property owners, at least as good as that existing before the improvement, and if the highway is on entirely new location, suitable passage shall be provided.
5. That the highway department will so handle the construction as to cause no damage to the property owner, and will construct such retaining walls, etc., as may be necessary for protection of his property.

Visibility.—Visibility or safe sight distance is a subject the importance of which has increased with the increased power built into modern motor-cars and the raising or removal of speed limits on state highways. It is important to provide clear-vision distances on vertical curves, since grade-line revisions are difficult and expensive. Combinations of horizontal and vertical curves, each of which classes may meet acceptable standards, frequently produce blind spots. Road and railroad grade crossings present special problems. In the latter case, legislation that will permit the appropriation of visibility rights over private property with due compensation is to be encouraged. Advertising signs that obstruct vision should be removed. Control of roadside trees and undergrowth can be exercised without destroying the appearance value of such growth. The following recommendations are made with regard to sight distances:

1. For all classes of highways of two or four lanes carrying 1,000 vehicles or more a day, a minimum sight distance of 600 ft. should be provided.
2. For a three-lane highway, 1,000 ft. clear-vision distance is recommended.
3. For two-lane highways carrying from 500 to 1,000 vehicles daily, where sharper curves are necessary because of the problems of financing, a minimum clear-vision distance of 400 ft. is recommended—500 ft., if possible within the limits of economy.
4. For two-lane highways carrying less than 500 cars daily, 300 ft. is recommended. This is based on providing for a speed of 30 m.p.h. on an 8 per cent grade with a 50 per cent allowance as a safety factor.

Grade Crossings.—The importance of a thorough consideration of all conditions and requirements—especially with regard to anticipated future changes—in all highway location problems was especially emphasized in the report on grade crossings and crossing elimination. The statement is made that "It is far better . . . that the crossing remain at grade rather than to separate the grades in an improper and dangerous manner." It is pointed out that in the state of New York the reconstruction is proposed of many grade-elimination structures built only a few years ago. It should be remembered that a project of unsatisfactory character, when once created in a community, is a reasonably permanent detriment to the general welfare of all the people.

There is really no such thing as "standardization" in the design of grade-elimination structures; however, certain limiting elements, such as grades, alignment and sight distances, may be stated, and others may be specified in a general way. The structure should not introduce a vision hazard which did not exist prior to its construction. A maximum grade of 5 per cent is indicated as desirable. More attention should be given to the appearance of structures, and the nature of the surrounding terrain must be taken into consideration in this connection. The possibilities in steel structures have not been exploited sufficiently from an appearance standpoint. Subways are believed to present a more pleasing appearance than overhead structures; however, the difficulty of providing drainage is often an obstacle to the subway type of design. A point to bear in mind is that the spread of double-deck bus lines over the highways would make 14-ft. underpass clearances necessary. It is advocated that, where two-lane usage in a grade-separation structure must be exceeded, the design advance at once to a four-lane project, since increasing traffic is bound to require the additional lane—frequently within a few years.

The report describes the policy of allocation of costs in effect in the state of New York. Ensuing discussion indicated the need for further discussion of the policies of various states in this respect. Attention was also drawn to the grade-crossing eliminations accomplished in many states through the relocation of portions of highways.

Bridges and Culverts.—The report on location as it

pertains to bridges and culverts stressed the folly of adopting bad locations to utilize existing old bridges. Where funds do not permit the construction of a bridge on a proper location, a proper location should be made, a gap left in the improvement and the existing road improved with traffic-bound material until sufficient funds are available. Bridge clearances to provide for future traffic should receive attention. Skew crossings may be utilized to secure better alignment and approaches; however, angles of over 45 deg. are objectionable and angles of over 60 deg. should never be used. Channel changes can frequently be made at small cost. Inadequate bridges having historic value present a problem which may be solved by widening or improving the approaches, or by a relocation.

Spur Roads.—The location of trunk highways to avoid congested city traffic and the building of spur roads to connect towns and cities and congested districts in general with such trunk lines is advocated. The solution of such problems must be based on traffic studies and predicted increases and other future conditions.

The complex problem of allowable grades received careful treatment in a report which pointed out that there is probably more indecision at present in grade design than in any other design factor. The principal desirable features to be taken into account in grade design are economy in construction costs, safety and visibility, economy in car operation and satisfactory drainage. Maintenance of roadway also enters into grade design, and a proper balance of grade against alignment factors must be made. The report discusses the conditions under which undulating grades are preferable to uniform grades, and indicates such limits as the following:

Under normal conditions high gear will efficiently carry heavy trucks up maximum sustained grades of about 3 per cent. Automobiles will similarly operate up about 7 per cent sustained maximum grade. Reduction of sustained grades less than 3 per cent is seldom justified by fuel economies on the composite vehicle. Between 3 and 7 per cent, heavy trucks suffer losses in lower gears and lost time which the lighter automobiles do not incur. For the automobile only, reduction in grade below maximum 7 per cent is justified by other considerations more than by fuel consumption. Grades in excess of 7 per cent become disadvantageous to all vehicles for so many other reasons than fuel consumption that 7 per cent appears to be a conservative allowable maximum for highway practice. Six per cent is a preferable maximum for general use and for sustained grades.

Maintenance of uniform safe speed is a convenient measure of the desirable grade, supplying reasons for reducing the maximum below that allowable on a basis of fuel consumption only. This leads to considering 5 per cent grade a desirable maximum on first-class roads, particularly when curvature is not excellent.

General.—The reports and discussions revealed the frequent existence of circumstances—political or otherwise—which placed the responsibility of location out of the hands of competent engineers, with the result that the public is forced to pay ultimately for a poor location. The sentiment of the session was for the promotion of a campaign of education to impress the point-of-view of the skilled and experienced locating engineer upon all others who may have a voice in determining the location of highway and related facilities.

Subgrades and Pavement Bases

An important report was that of the Committee on Subgrades and Pavement Bases, the chairman of which is A. T. Goldbeck, director, National Crushed Stone Association. This, the third report of the committee, is devoted primarily to the subgrade and base problem as it is observed in cities. Data for this report were collected by James S. Burch, assistant engineer, American Road Builders' Association through questionnaires and investigational visits to city engineering departments and state highway departments. Conclusions of the 1931 report, as approved by the committee, are as follows:

1. Because of the variability of controlling factors and the lack of complete experimental data, it is difficult to design bases with mathematical exactness. Our design, as nearly as possible, should be based on theory as modified by performance in service.
2. Until legal wheel-load limits are established and properly enforced, pavement design based on traffic loads can be approximate only.
3. The increasing use of pneumatic tires on trucks and the increasing smoothness of pavement surfaces appear to require less consideration for impact stresses in the design of pavements and bases.
4. The outstanding subgrade trouble observed in cities in this survey comes through the existence of improperly backfilled trenches under the pavements.
5. All soil types and conditions necessitate careful workmanship and thorough inspection in backfill work or special-strength design in the base.
6. Where concrete pavements or bases are placed over trenches subject to further settlement, the slab should be designed as a beam.
7. The successful service of non-rigid bases, such as gravels and macadams, requires primarily a soil offering high intensity of support, non-elastic character of support and adequate drainage of free water.
8. Preliminary study of subgrade soil conditions will indicate, in general, subgrade character and its influence on the pavement base, and will permit more rational pavement design.
9. Much progress has been made in soil research, but there is much work to be done before we can apply subgrade data to pavement design with mathematical precision. Soil and subgrade study is a highly specialized subject and should be treated as such.
10. Regardless of soil type, the subgrade should be in a thoroughly moist condition prior to placing concrete. Alternate methods, such as bituminous subgrade treatments, the use of tar paper and other methods have been satisfactorily used under favorable curing conditions.
11. The benefit of rolling prior to placing concretes lies primarily in smoothing and in lightly and uniformly compacting the subgrade. The use of a comparatively light roller (3 to 7 tons, 125 to 250 lb. per lin. in. width of roll) is considered as desirable, and in many soils more desirable than a roller of heavier weight (10 to 15 tons, 350 to 500 lb. per lin. in. width of roll).
12. A large percentage of the cracking in concrete bases is due to initial stresses created by forces other than those due to load, and in many cases followed by progressive failure due to traffic.
13. The economic advisability of using lean-mix bases on wet subgrades is questionable. This is especially true where bases are subject to freezing or to the chemical action of subgrade waters.
14. Of the cities covered in this survey, the majority require compressive strength in base concrete varying between 2,000 and 2,500 lb. per sq. in. at 28 days.
15. Best economical deisgn practice requires that the deter-

A. T. Goldbeck

James S. Burch, Jr.

mination of thickness of concrete slab be based on maximum vehicle wheel load rather than on the number of vehicles using the pavement during a given period of time.

16. The general appearance and indicated length of life of all pavements on adequately reinforced bases observed in this investigation were better than for similar pavements on comparable plain bases.

17. In cases observed where transverse base joints were used (at 20 to 80-ft. intervals) in connection with well distributed reinforcing broken at the joint, the number of visible transverse cracks was considerably reduced, as compared to similar cases where continuous reinforcing was used.

18. Except when used in connection with joints at frequent intervals, reinforcing in the amounts generally used does not appear to decrease consistently the number of *visible* transverse cracks, but does decrease the number of *wide* cracks. This is true both in concrete bases and in concrete pavements.

19. Adequate reinforcing, when used with joints at reasonable intervals in concrete bases and pavement, effectively eliminates wide cracks and materially decreases the number of visible cracks.

20. Vertical displacement of fractured slabs observed in plain pavements and bases was not observed in reinforced bases subjected to comparable conditions.

21. The characteristic of aggregates used and methods of curing employed on concrete bases and pavements were observed to have a decided effect on both the number and size of cracks in plain slabs and to a lesser extent on reinforced slabs.

22. A decided lack of interest is observed in the curing of city concrete bases. Current practice in this work indicates that curing requirements and their enforcement are very often lax.

23. Observations indicate that where concrete is used as a resurfacing medium, provision for low sliding resistance between slabs, frequent use of joints and well distributed reinforcing are beneficial in the elimination and control of cracking.

24. To secure proper slab thickness and uniformity of subgrade surface contour, it appears advisable that some form of subgrade strike-off board supported by forms or curbs be required in the construction of concrete bases as well as pavements.

25. More serious consideration should be given to the relief of stresses set up in a concrete pavement by reason of shrinkage, temperature and moisture changes. The development and more widespread use of expansion and contraction joints would improve pavement service.

26. It is recommended that city departments employ more extensively the practice of drilling cores from concrete pavements and bases as a check on the quality and thickness of the slab as actually constructed.

Maintenance of Traffic-Bound Roads

The report of the committee, of which H. G. Sours, county engineer, Summitt County, Ohio, is chairman, was in the form of an outline covering the various phases of traffic bound maintenance.

The outline was as follows:

Size and Quantity of Materials.—First application may be up to 1½ in. although usually from 1 in. down. Subsequent applications should pass ¾ in. screen. From 1,000 to 1,500 cu. yd. per mile should be used on first application, bladed in windrows along the sides. Subsequent applications should be light so as to maintain a small single windrow bladed alternately from side to side.

Use of Local Low Cost Materials.—Bank run gravel, sand clay, shale, etc., may often by used at considerable saving in cost, especially for first application. Pea gravel makes an excellent mulch material for surface maintenance.

Blading and Dragging Equipment.—One-man grader or tractor blade combination for heavy blading. Multiple blade drag is preferable for smoothing and leveling loose surface material.

Blading and Dragging Operations.—On newly surfaced road the grader is used to best advantage in bringing material from windrows and in shaping the surface. Also whenever the surface becomes rough and requires cutting to smooth it, especially in the fall and spring and after rains during summer. The multiple blade drag is best fitted for keeping the road smooth but must have loose material to carry in front of the blades.

Crowns.—Low crowns in dry weather to be bladed somewhat higher before winter.

Seasonal Maintenance.—In summer keep surface material thin as possible; it makes easier driving and provides less material to grind up and dust off. In spring and late fall carry heavy layer of loose material; this is the time to work in the material and build up thickness of metal. Placing material in mud will do no harm.

Dust Prevention.—Use of calcium chloride is desirable until such time as the road is built up to a point when it is ready to treat with bituminous material. It prevents dusting, loss of material and assists in maintaining a smooth surface with less blading; it also speeds up the compacting of the surface. Bituminous treatments and mixed in place tops forming a more or less permanent surface should be used after sufficient base has been built up to resist breaking through. This type of surface provides excellent riding qualities and eliminates blading maintenance.

H. G. Sours

H. J. Spelman

Highway Embankments

The committee on Grading Methods and Grading Equipment, of which H. J. Spelman, chief engineer, West Virginia State Highway Department, is chairman, decided that for the current work its efforts shall be confined to the study of construction and compaction of embankments. As a result its report covers only this subject.

A review of state, county and city highway department specifications disclosed many variable methods of constructing and compacting embankments. Practically all specifications require the embankment to be placed in layers for the full width of the cross section. However, the thickness of the layers varies from a 6 in. minimum to a 24 in. maximum, while occasionally a specification will contain no maximum limit.

Methods of compaction were found to be as variable as the methods of placing. These methods include the use of rollers of various types and weights, trucks, track-type equipment, wheel-type equipment, jetting, ponding, the use of explosives, tamping and puddling. On reviewing the data at hand, the committee adopted the following conclusions:

1. Highway grading practice and construction methods are largely an inheritance from past railroad practice, and the attitude of engineers and contractors toward placing embankments has been largely ifluenced by this inheritance. The need for compacting railroad fills was not great because the railroad roadbed was flexible, whereas the highway pavements must be maintained at the same elevation without filling on the surface.

2. The assumption that the action of the elements and traffic will bring about the complete settlement of an uncompacted embankment in two or three years is usually incorrect.

3. Since the natural settlements are necessarily slow, and traffic and the elements cannot be depended upon to produce complete and uniform settlement, even over a considerabl period of time, artificial compaction methods must be employed, if settlement is to be obtained before surfacing is placed.

4. As the nature of soils varies widely even in small areas, a knowledge of the character of the material to be compacted, as well as the materials on which it is to be placed, is necessary before the engineer can intelligently decide on the best method of compaction.

5. The major source of trouble in embankment construction has been the failure to enforce the specifications as regards the actual thickness of the layer of loose material placed, and the method of compaction required.

6. The results obtained through laboratory diagnosis and control in constructing and compacting embankments are most excellent. This procedure is somewhat new and is worthy of further study by this and other similar committees.

7. Adequate compaction can be secured with various types of rollers. There is need for general revisions of specifications for rollers which will express weights in terms of load per lineal inch rather than gross weight of roller. Other types of compaction equipment such as wheel and track type equipment, have been successful for compaction of embankments of certain types and in certain localities. Studies should be made to determine proper weight pressures of compaction equipment for different types of soils.

8. Regardless of the method of compaction, the use of a power driven mechanical device for spreading the fill material evenly in layers is essential if the best results are to be obtained.

9. With certain types of soil, effective compaction can be obtained by the introduction of water into the fill. Further information is needed as to the types of soil with which these methods can be successfully used.

10. Swamps, marshes and peat bogs represent the most treacherous areas over which modern highway embankments are constructed. The use of explosives is particularly successful in displacing underlying unstable material and compacting embankments in such areas.

Central and Truck-Mixed Concrete

The Committee on Central and Truck Mixed Concrete, of which Col. R. K. Compton, director of public works, Richmond, Va., is chairman, in its report stated that the production of ready mixed concrete in 1929 was in excess of 7,000,000 cu. yd. The term "ready mixed concrete" as used in the report is taken to mean portland cement concrete mixed at a central mixing plant and hauled to the job; or the aggregates proportioned at the plant and the product mixed at the plant, in transit or at the job, in a truck mixer. The conclusions presented in the report were as follows:

Ready mixed concrete, manufactured under proper supervision, is acceptable for all types of concrete construction.

The ready mixed concrete plant should be equipped with weighing devices, meeting the specification of the American Road Builders' Association for weighing devices for concrete aggregates, and as used by various state highway departments.

For low slump concrete the "non-agitating" type of truck is satisfactory as hauling equipment under proper supervision, and gradation of aggregates.

Specially designed water-tight bodies with rounded corners should be required when open type dump bodies are used.

The so-called "agitator" type of body has proved satisfactory for hauling concrete of any slump under proper supervision and gradation of aggregates.

Satisfactory concrete can be secured by truck mixers provided proper supervision and gradation of aggregates is exercised.

The use of central mixing plants, the transportation of mixed concrete and the use of truck mixers may be permitted provided there is no segregation of material when the concrete is deposited on the subgrade.

The concrete may be hauled not to exceed one hour, except by special permission of the engineer, and must reach the subgrade in such plastic and workable condition that the slump, on the job is within the limits specified.

Any concrete which is not plastic and workable when it reaches the subgrade should be rejected.

It may be pointed out that there is generally a change of slump with the elapse of time after mixing. This should be taken into consideration in arriving at a suitable water-cement ratio applicable to each job. In this respect complete cooperation is necessary between the engineer and the operator.

The methods of transferring the product from the hauling unit and depositing same on the subgrade have been discussed as well as the protection of subgrades requiring such protection. Where no mesh reinforcing is used, it was suggested that light steel channels be used for truck runways. These channels should be in sections preferably 5 ft. in length. Where reinforcing mesh is used, portable swivel type conveyors to take care of at least 20 ft. of subgrade could be utilized.

The use of bulk cement frequently presents an economic and, from an engineering standpoint, thoroughly satisfactory operation. However, the decision in this matter should be reached after an investigation as to the adaptability of the project to be constructed to such a method.

Engineers, in permitting the use of ready mixed concrete should, at all times, satisfy themselves that the operator is sufficiently equipped both from the standpoint of personnel and mechanical equipment, to produce and deliver the product in sufficient quantity and of a quality which is acceptable.

R. Keith Compton

W. F. Rosenwald

Use of Ready Mixed Concrete.—The results of a questionnaire sent to all state highway departments and to 102 cities are summarized in the report as follows:

Of the 42 states replying, 23 permit under their specifications, or under special provisions the use of ready mixed concrete; 16 do not, and 3 simply state that they have had no experience. Three, in the case of central mixing plants, required the product to be agitated enroute. The maximum time allowed between mixing and placing varies from 30 to 60 minutes with the average being 40 minutes. The slump test is used in 30 of the 42 states. The maximum slump for one course concrete pavement reported is 3.5 in., the minimum 1 in., and the average 2 in. For concrete base 4 in. is the maximum, 1.25 in. the minimum, and 3 in. the average.

Of the 56 cities tabulated, 38 permit the use of ready mixed concrete, 11 do not permit its use, and 7 state that they have had no experience with this method. The time allowed between mixing and placing varies from 10 to 60 minutes, with the average being approximately 45 minutes. The slump test is practically universally used with the average slump for one course concrete being 2 in. and for concrete base 3 in.

Snow Removal and Equipment

The recommendations of the Committee on Snow Removal and Equipment, of which W. F. Rosenwald, maintenance engineer, Minnesota State Highway Department, is chairman, were adopted after a careful review of data compiled from information furnished by 23 state highway departments. The committee recognized that success in snow removal depended upon:

"Early attention; adequate equipment; qualified operators; complete control; constant application; greatest speed possible, with drift prevention and elimination of icy and slippery conditions supplementing the actual removal.

The recommendations given in the report are:

I. That snow removal equipment be classified as to type at normal operating speeds as follows:
   - A. Slow—up to 5 miles per hour.
   - B. Intermediate—5 to 15 miles per hour.
   - C. High—15 miles per hour—up.

   For rural roads, or sparsely-populated suburban streets:

Class A, Slow:
a. Tractor-operated displacement plows.
b. Rotary plows.
Class B, Intermediate:
a. One-way blade displacement type truck mounted.
b. V-plow displacement type truck mounted.
Class C, High:
a. One-way blade speed type truck mounted.
b. V-plow speed type truck mounted.
For urban and suburban streets:
Class A, Slow:
a. Tractor-operated displacement plows.
b. Loaders.
c. Sidewalk plows.
Class B, Intermediate:
a. One-way blade displacement type truck mounted.
b. V-plow displacement type with and without wings truck mounted.

(Effective snow removal demands the use of more than one type of equipment on the same road according to road and storm conditions encountered, and under varying conditions the grouping of equipment according to classes as herein given may not prevail.)

II. That the following improvements be made in equipment:
A. The attachment features and hitches of plows be standardized so that the several types and makes of plows may be interchangeable.
B. The working surface of the snow blade be polished, treated with rust resisting material and coated with suitable wax to eliminate friction.
B. All equipment be fitted with cabs fully enclosed, tightly built, properly ventilated, roomy and comfortable, and heated if possible but not by use of exhaust heaters.
D. The elimination of the use of exhaust heaters on snow removal equipment by appropriate regulation or legislation.

III. That traffic hazards be reduced by:
A. Emphasizing locations of protruding wing and blade ends by suitable markings, preferably flood lighted at night.
B. Marking the equipment to distinguish it as snow removal equipment by color, signs or other means.

IV. That organization of operating force and distribution and operation of equipment be in accord with the following general practice:
A. That the operating personnel be organized and controlled by supervisors within suitable local areas, and that the operators be selected from the permanent maintenance force assigned to the particular area because of their familiarity with local road conditions. Prior to the snow season the operators should erect suitable markings which will remain visible above the snow and indicate to them the location of headwalls and other obstructions.
B. That snow units be assigned to definite sections of roadway. That a reasonable number of replacement units of similar type be maintained for use in case of break downs. And that these usual units be supplemented by reserve or emergency equipment for severe conditions.

(Suitabl shelter for equipment and an adequate number of field shops for repairs should be conveniently located. No recommendations as to mileage per unit is made because of the variable conditions encountered. Only experience can dictate the equipment necessary for the circumstances to be anticipated in the respective localities.)

C. One-man power tractor graders are uneconomical for snow removal, and their use should be discontinued as promptly as more practical snow removal equipment can be made available.
D. Snow should be removed down to the road surface, if possible.

V. That snow removal programs include, be accompanied or supplemented by measures to prevent icy or slippery conditions, promptly and rapidly applied by mechanical means, to care particularly for steep hills, curves, dangerous intersections and those highways that constitute village or town streets in heavy traffic areas.

(A combination of sand, slag or cinders with Ca Cl_2 in 35 per cent solution has proved practical, the solution being prepared by mixing 100-lb. of Ca Cl_2 with 13 gal. of water to produce 19 gal. of mixture, and applied in sufficient quantity to saturate the piles of aggregate.)

VI. That the formations of drifts be controlled by the erection of snow fence or other means to permit the usual removal equipment to operate effectively.

VII. That standardized systems be established for keeping of costs of snow removal.

Grade Crossings and Highway Intersections

This committee, of which R. H. Baker, state highway commissioner, Nashville, Tenn., is chairman, presented a comprehensive report dealing with many aspects of problems which are increasing in perplexity yearly.

The principal factors involved in this problem, the report observes, are loss of life and loss of time. Because of the increasing construction of highways, the number of railway grade crossings is steadily increasing despite a growing program of elimination. It is evident that a satisfactory solution of this problem cannot be obtained by any one method. The ultimate solution will be derived from a program embracing the scientific elimination of grade crossings by grade separation or road relocation, together with a greater use of grade-crossing protection.

The number of railroad grade crossing accidents and fatalities has been nearly constant during the past four years, despite increasing traffic volume and number of crossings. Approximately 2,500 persons are killed annually at railroad grade crossings. Protective measures, instruction and publicity, have assisted in preventing a rising death toll during recent years. The following is a record of grade-crossing accidents in 1928 according to types of protection. This record, however, is not conclusive because of lack of information concerning the various crossings.

	Gates	Watch man	Visible and Audible Signals	Visible Signals	Audible Signals	Fixed Signs	No. of Signs
No. of crossings	5,707	7,297	8,004	3,635	4.572	204,933	4,941
Accidents	179	643	331	440	318	3,841	

Total number of crossings: 240,089
Total number of accidents: 5,752

In recent years relocation of highways has been a much more important factor in elimination than grade separation. From 1927 to 1928 a total of 4,291 crossings has been eliminated on the federal-aid system. Of these, 947 were eliminated by separation and 3,347 by relocation of highways. Of the 390 crossings eliminated in 1928, 107 were grade separation and 283 were consummated by highway relocation.

The cost of various methods of protection varies, automatic signals approximating a minimum of $400 and a maximum of $12,000, with annual maintenance, depreciation and operating costs averaging 10 to 20 per cent of installation. Gates average $1,278 per crossing for installation with an average cost for maintenance, operation and watchman's wages of $3,000 annually.

With regard to highway intersections, the report points out that the efficiency of the highway is dependent on freedom from delays at intersections. Just when the cost of these delays is sufficient to justify the elimination of the crossing is the problem under discussion. If a highway is designed for a traffic capacity of 8,000 vehicles daily and through a traffic study it is found that by reason of numerous highway intersections the capacity is reduced to 4,000 vehicles, it is evident that there is justification for a certain expenditure for elimination in order that cost of transportation may be reduced to a minimum.

A traffic study should furnish a fairly accurate estimate of the volume of each classification of traffic using the highway. In the New Jersey study for the entrance to the Holland tunnels, the cost of delays per car per minute amounted to 2.3 ct. for trucks, 2.1 ct. for

R. H. Baker

C. N. Conner

light commercial vehicles and 1 ct. for non-commercial vehicles. The traffic study indicated 50 per cent of the traffic volume to be trucks, 25 per cent light commercial vehicles and 25 per cent non-commercial vehicles. The average value of delays per car per minute, therefore, amounted to 2 ct.

The committee observes that the economic cost of motor-vehicle accidents has increased $350,000,000 in six years, of which highway intersections may account for 50 per cent, and offers the following summary of conclusions:

1. There should be a definite classification of railroad grade crossings by each state based on the relative value to the traveling public of their elimination, such study to be divided as between geographical subdivisions of the state and to carry as a factor the financial ability of the carrier and the political subdivisions to participate in the cost of elimination.
2. There should be a definite annual program by each railroad in each state for the elimination of grade crossings of highest classification, when such a program would not menace the financial stability of the carrier.
3. Authority to create new railroad crossings should be restricted to the state utility commission, for the reason that an impartial third party should be the judge as to the necessity for the additional crossing.
4. There should be a definite progressive program in each state for installing protective measures or devices of standardized type. This is to include train-approach warning signals where necessary.
5. Cost of elimination and installation of protective measures should be shared by railroads and interested parties.
6. There is need for complete application of standard signs, markings and protective measures at dangerous highway intersections.
7. It is evident that motor-vehicle accidents at intersections can be greatly reduced by adoption of regulations recommended in the Uniform Vehicle Code.
8. Highway grade separations have become an economic necessity on many urban highways in order to obtain maximum highway capacity and reduce time losses.
9. Where potential elimination projects exist, necessary extra right-of-way widths should be secured if possible before costs become prohibitive.
10. Scientific traffic analysis has developed rapidly in recent years, as a result it is possible to evaluate vehicle time losses and determine justifiable grade-separation expenditures.

Low-Cost Roads and Bridges

Due to the demand for a greater mileage of serviceable highways the interest in low-cost roads has increased greatly in the past five years. No standard methods of planning of these roads are in use nor has a study been made of those methods which have proved successful or unsuccessful. The report on "Construction and Maintenance Methods for Low-Cost Roads" is therefore of much interest. This report which was prepared and edited by C. N. Conner, engineer-executive, American Road Builders' Association, is divided into four sections: I, Financing and Planning; II, Grading; III, Surfacing; IV, Bridges and Culverts.

Financing and Planning

A summary of the conclusions in this section of the report follows:

1. Highways of general motor use should be financed by users of the highway—gas tax and registration fees.
2. Highways of local use only should be financed, in part at least, by local taxes, or special assessments, limited by the benefits resulting from the improvement.
3. When there is an urgent need for highways and a fixed income exists, bonding is recommended. After the initial construction is completed, programs may be carried on by use of current funds, and in special cases augmented by small bond issues.

Funds for construction of low cost roads can be greatly increased by the elimination of much unproductive mileage.

Consolidation of poorer, sparsely populated counties into districts will combine resources and make funds available for necessary highway improvements.

6. With approximately 2,000,000 miles of highways in the United States yet to be improved, the popularity of low cost road construction will increase rapidly, the proportion of funds to be used on this construction can only be determined by careful transport surveys.
7. Highway districts and townships, should be eliminated as highway supervising units—these highways should be administered through efficient county highway engineering departments.
8. The state aid system which should comprise the county trunk line system, should be financed by state and local funds and supervised by the state.
9. When the state system has been improved sufficiently to satisfy transportation demands with at least passable connecting highways, county trunk highways should be selected to receive a portion of state funds for construction.
10. Where county financing is done by bonding, serial bonds should be utilized, the retirement period not to exceed 20 years. The bonds should be sold no faster than the proceeds can be expended.
11. Inasmuch as approximately 75 per cent of highway construction costs go into labor, the construction of necessary highways in outlying regions is particularly recommended. Construction activity of this nature does not remove labor from its source and furnishes relief in areas where it is most needed.

Grading

The roads considered were only those whereon the average daily traffic is not expected to exceed 300 vehicles per day. Some of the features brought out in the report were as follows:

Stage construction or progressive development of the roadway is strongly urged. The idea is that the initial alignment, grading and subsequent surfacing should be such that all will be utilized in any future development of the road structure.

Control points should be located preliminary to stage construction keeping in mind the required service, the standard of construction and whether a given section is to be temporary or permanent.

The same standards as to alignment, grade and cross-section cannot be maintained in mountain location as in level country.

Standards for Alignment and Grades.—The following alignment and grade standards for roads carrying less than 300 vehicles per day are given in this report:

1. In Level and Gently Rolling Country.
   - Minimum sight distance ..... 250 ft.
   - Minimum radius of curvature at right-angle turns—level ..... 200 ft.
   - Minimum radius of curvature on steep grades ..... 400 ft.
   - Maximum grade ..... 7 per cent
2. On Mountain Location.
   - No minimum sight distance .....
   - Minimum radius on steep grades ..... 100 ft.
   - Minimum radius on very bad location ..... 50 ft.
   - (Grades on 50 ft. radius to be not over 4 per cent.)
   - Maximum grade ..... 10 per cent

Cross-Section.—One of the points on which there was general agreement at the 6th International Road Congress, Washington, D. C., October, 1930, reads:

"A 10-ft. travel lane is preferred. Difference of opinion on whether first to have 2-lane, or 1-lane roads with passing places."

One of the reports at the same meeting said:

"In a country of steep side slopes the main opportunity for initial economy is in width."

Turn outs should be provided in all roads 14 ft. in width or under at intervisible distances.

Slopes.—Recommended cut and fill slopes are given as follows:

Fills—Earth—Never less than 1½ to 1.
Fills—Rock—1 to 1.
Earth cuts—¾ to 1 even—½ to 1 sometimes.
Rock cuts—¼ to 1 even—1/6 to 1 sometimes.

Surfacing

This section of the report briefly stated the essential steps in stage construction as exemplified by the experience of engineers who have been successful in building road surfaces at the lowest cost. The conclusions given in the report are as follows:

1. There is an ever-growing use of low cost types of surfacing which will continue.
2. Stage construction is justifiable when traffic conditions and funds are insufficient to warrant high type surfacing.
3. Effective temporary surfaces of cheap local material may sometimes be wasted with ultimate economy, provided they have given all weather service and show reduced vehicle operation and surface maintenance costs as compared with earth surfaces.
4. The blading and dragging of the principal types of low cost bituminous surfaces, including surface treatments and bituminous macadam, result in smoother riding surfaces, lower maintenance costs and fewer failures, than when blading and dragging are not done.
5. Engineers responsible for low cost construction and maintenance are not generally satisfied with the experience of others; they feel that they must perform their own experiments with their own local materials on experimental sections.
6. In some instances low cost surfaces have failed because their grade line was not sufficiently elevated above the level of ground and capillary water. This is evidenced because adjacent sections having the same type of surfacing, but with grade lines elevated on shallow fills, did not fail.
7. There is sufficient information available on low cost roads, which if utilized, would make possible excellent surfaces on the majority of our secondary and tertiary highways at an initial cost for surfacing of less than $10,000 per mile for a width of 18 ft.
8. The service value of an improved road is measured by its services to the taxpayers and must not be confused with annual road cost which is the total yearly expenditure that will construct, replace and maintain the road in serviceable condition. There is need for more accurate measurement and evaluation of service values and road costs for all types of highway improvements.
9. Simplification and standardization of methods and specifications are needed in low cost road practice.
10. There is a tremendous field for development in equipment, methods and materials now used or that may be used in the construction and maintenance of low cost roads.
11. Mechanical equipment made low cost roads possible, gave them smooth riding surfaces, and only by a wider use of adequate mechanical equipment can we expect to solve the physical features of the low cost road problem.

Bridges and Culverts

The subject of low cost bridges has long needed study and in this report the American Road Builders Association presents the initial effort. The results of this study, which has occupied two competent bridge engineers for a long time, was given in the report in the form of conclusions and brief summaries. It is planned to issue later on the complete report on low cost bridges as a separate bulletin.

Comparative Costs of Various Types of Bridges.—In connection with the report estimates of cost of several types of bridges were given. These costs are summarized in the accompanying table. In all cases the bridges were built in the period from July, 1928, to July, 1930, and were designed for a 15-ton truck capacity. The total cost includes 10 per cent for incidentals but does not include earth approaches.

Trends of Practice.—The present trends of practice are summarized as follows in the report:

1. Existing bridges are being widened.
2. New bridges are being made from 4 to 10 ft. wider than in 1928.
3. Bridges are being built with the grade line on a long-radius camber curve, giving long sight distance and good riding conditions.
4. Steel I-beams are being used to a greater extent in several ways:
   a. In the place of pony-truss spans in lengths up to 90 ft. by splicing for continuity, and due to the availability of I-beams 33 in. and 36 in. in depth.
   b. Instead of reinforced concrete spans where economical due to low price of steel beams.
   c. Instead of creosoted timber for stringers and caps of creosoted timber pile bents due to low price of steel.
   d. In the place of plate girders, both deck and through, due to possibility of adaptation without shop work and neat appearance.
5. Concrete floors are being used instead of timber for all kinds of bridges except bascule draw spans.

COMPARATIVE COSTS OF SEVERAL TYPES OF BRIDGES

	(1) Ave., 17 Bridges	(2) Ave., 27 Bridges*	(3) Ave., 7 Bridges†	(4) Ave., 10 Bridges	(5) Ave., 7 Bridges‡
Total length, ft.	1,043	361	888	972	748
Roadway width, ft.	20	20	20	20	20
Panel length, ft.	26	38	34	28	21.5
Concrete, Class A, per cu. yd.	$19.94	$22.02	$20.08	.....	.....
Treated timber, per M. ft. B. M.	.....	.....	.....	$118.28	$110.50
Untreated timber, per M. ft. B. M.	.....	.....	.....	.....	75.00
Treated piles, per lin. ft.	.....	.....	.....	1.083	1.15
Concrete slab, per cu. yd.	.....	.....	.....	21.85	20.59
Reinforcing steel, per lb.	.046	.0513	.049	0.047	0.06
Structural steel, per lb.	.....	.....	.053	.057	.....
Concrete piles, per lin. ft.	3.45	.....	4.31	.....	.....
Railing, per lin. ft.	1.81	.....	.....	.....	.....
Total cost, including 10 per cent	$57,000	$35,380	$71,690	$54,000	$29,800
Cost, per lin. ft.	$54.65	$98.00	$80.73	$55.55	$39.80
Cost, per sq. ft.	2.73	4.90	4.04	2.77	1.99

(1) Estimate of cost of concrete pile trestle highway bridges, having concrete girder and slab superstructure. Approximate average for 17 bridges located in Arkansas, Colorado, Florida, Mississippi, North Carolina, Oklahoma and Texas.

(2) Estimate of cost of concrete deck girder highway bridges having concrete piers and abutments. The cost approximate averages for 27 bridges located in many states.

(3) Estimate of cost of concrete pile trestle bridges having steel I-beams, stringers and concrete floors. Approximate averages for 7 bridges located in Colorado, Missouri, Oklahoma and Texas.

(4) Estimate of cost of creosoted timber pile trestle highway bridges having steel I-beam stringers and concrete floors. Approximate averages for 10 bridges located in Oklahoma, Colorado, Louisiana, New Mexico and Virginia.

(5) Estimate of cost of creosoted timber pile trestle highway bridges having timber stringers and concrete floors. Approximate averages for 7 bridges located in California, Colorado, Missouri, Nebraska and Texas.

*The relatively short length of bridge and longer span in these bridges would tend to increase the cost per lineal foot.

†These bridges include expensive foundations with consequent high averages cost for the group.

‡The design capacity varied from 10 to 15-ton trucks. The untreated timber consists of railings. The treated timber consists of wheel guards, stringers, caps and bracing.

H. C. Whitehurst

George B. Sowers

6. Roadways are being made 24 ft. wide for two lanes of traffic, 30 ft. for three lanes and 40 ft. for four lanes.
7. Raised or high curbs and very much stronger railings are now being made than formerly.
8. Improved alignment is sought consistent with speeds of 45 to 60 miles per hour.
9. Roadways are being kept clear of obstructions to a greater extent than ever before. The underpass with pier, in the roadway will be condemned as dangerous.
10. The alignment, grade, sight distance, width of roadway and proper crown of small amount on tangents and superelevated for curves are being made for safely moving vehicles at speeds of 45 to 60 miles per hour.
11. The live loads used for designing bridges have been increased from 15-ton trucks to 20-ton trucks by several state highway departments to care for heavy single units and combinations of several heavy units in trains from 60 to 80 ft. long.
12. The clear height of roadway opening has been increased from 14 to 15 ft. in some states and to 16 ft. in one state. The portal brackets and similar encroachments are being removed from present bridges and carefully avoided in new structures.
13. The curbs and bottom rails are being made strong with a view of stopping a moving vehicle from going over the side of the bridge. They are being made smooth on the inside for a height of 2 ft. above the pavement so as not to catch wheels. The type varies in snowy regions to avoid causing snow being deposited on the bridge.
14. Light colored paint, light gray, blue, white or aluminum is being extensively used on railings, trusses and girders of through bridges for good visibility in all times of day or night and in all kinds of weather.

City Officials' Division

Committee reports presented at the city officials' session embraced the subjects of organization, administration and finance; design and construction, maintenance and traffic. In addition to these, W. A. Hardenbergh, associate editor of *Public Works*, discussed public works and unemployment in relation to the responsibility of local officials in providing relief.

Organization, Administration and Finance.—As a result of a study made by this committee, of which H. C. Whitehurst, engineer of highways, District of Columbia, is chairman, for the purpose of determining the practice of representative cities in making assessments for paving, the following recommendations for standardization were presented:

1. That city officers have discretionary powers in the selection of type.
2. That intersections be paid for by the city from general paving funds.
3. That on pavements of excessive width part of the cost come from general paving funds.
4. That payment be made to contractors in cash from city funds.
5. That repaving of surfaces 20 years or more in age be by general assessment; of less age, largely from general paving funds.

Design and Construction.—This committee, under the chairmanship of George B. Sowers, commissioner, Division of Engineering and Construction, Cleveland, Ohio, presented only a small amount of the information which had been collected from over 150 cities. A digest of this information indicates that nearly all of the city engineers are satisfied with the results they are getting from their paving, although each one seems to be seeking to improve his practice.

Black-base construction seems to be increasing in popularity, especially where trouble is experienced with frost or with swelling sub-soils. Division of opinion is noted in the concrete paving practice, especially with regard to the use of reinforcing steel and to curing methods. Winston-Salem, N. C., reports the use of sodium silicate for curing concrete sidewalks. Experimental types of expansion joint for concrete bases reported included a cork joint (Pittsburgh, Pa.), a ¾-in. air joint every 30 ft. covered with a layer of tar paper before the bituminous surface is laid (Kent, Ohio) and a ½-in. joint filled with a dry mixture of 90 per cent sand and 10 per cent cement (Monessen, Pa.). A feature of this session was an animated discussion on street-railway track paving, characterized by decided differences of opinion. A paper by John M. Tippee, city engineer, Des Moines, Iowa, traced the development in city paving work and contrasted many of the lax methods of construction of only a few years ago with the demands of present-day specifications.

Maintenance.—A detailed report, prepared under the chairmanship of A. T. Rhodes, superintendent of streets and sewers, Leominster, Mass., was presented under the following heads: surfaces of all types, street openings or cuts, street cleaning, resurfacing and salvaging of existing pavements, unpaved streets. The statistical matter included in this report was collected at first-hand from officials of some twenty cities by C. R. Thomas, engineer-executive, City Officials' Division.

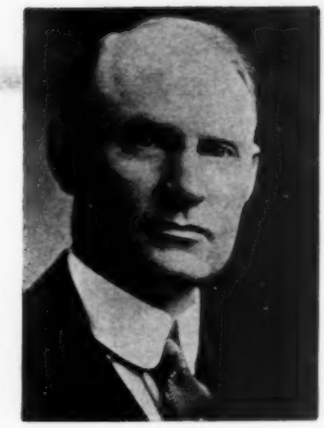
Good equipment and materials, trained and experienced supervision and immediate investigation and correction of pavement failures were listed as essentials of low-cost maintenance. Considerable discussion was devoted to the return of a portion of state gas-tax and license funds to cities for maintenance purposes.

The report of the sub-committee dealing with street openings and cuts recommends that all public utilities be installed before paving. The opinion of the session seemed to favor the installation of sewers and water connections before paving as well, although this was not concurred in by all present. In University City, Mo., gas mains are installed under one lawn and water mains under the other; service connections are made by boring under the pavement. Sewer connections are extended to the curb before paving. It is pointed out that, in the cities studied, very little attention is paid to reinforcing, battering or doweling new cuts to the old pavements, and that very little use is made of accelerators or quick-hardening cements. There are, however, outstanding exceptions to the second of these rules of practice, some cities finding the use of accelerators, quick-hardening cements and extra-rich concrete mixes indispensable. More attention should be paid to backfilling after cuts have been made. Some cities require machine tamping before repaving.

There would appear to be room for the introduction of further economies in street cleaning. St. Louis, Mo., has experimented successfully with vacuum cleaning

A. T. Rhodes

Charles R. Thomas



M. O. Eldridge

of sheet pavements, as well as some brick and granite-block pavements, by contract. The need is felt for further information relating to chemical methods of snow and ice removal. The great majority of the cities represented require traction companies to remove snow and ice from their tracks.

The following may be noted among the conclusions relating to unpaved streets: "Any properly constructed gravel road is a potential base for all ordinary types of roadway, up to and including concrete." This type of stage construction is suitable for towns with insufficient revenue for extensive paving or for undeveloped areas of large cities. The use of ashes for unpaved streets has met with success in York Township, Ont.

Traffic.—A report on recommended street capacities was presented by M. O. Eldridge, assistant director of traffic, District of Columbia. Some discussion centered about the best curb-to-curb width of business streets. It was pointed out that a width in excess of the minimum requirement for two lanes of parking plus two lanes of moving traffic encourages the attempt to form an additional traffic lane with its attendant hazards. In addition to this, additional width beyond the minimum requirement is an encroachment upon sidewalk space, which is often insufficient in the congested centers of large cities. The need was expressed for a study of the practices of cities in cutting circular corners. The committee report favors the limitation of vehicle widths to 96 in. and the encouragement of pneumatic-tired equipment—especially in the case of heavy commercial vehicles.

National Paving Brick Manufacturers Association Meets in February

The 25th annual meeting, the silver anniversary of the National Paving Brick Manufacturers Association, will be held Feb. 5 and 6 at the William Penn Hotel, Pittsburgh, Pa. An interesting technical program consisting of papers and discussions of various phases of the highway transport problem, especially as they relate to the use of vitrified brick as a paving material, has been prepared. The tentative program follows:

THURSDAY, FEB. 5

FIRST GENERAL SESSION (BALL ROOM)

MORNING—9:30 A. M.

1. Modern Practices in Brick Paving.
   (a) "City Streets," by Lyons Mussina, city engineer, Williamsport, Pa.
   (b) "County Highways," by Richard M. Rumsey, Niagara County, superintendent of highways, Lockport, N. Y.
   (c) "From the Contractor's Viewpoint," by Sam F. Pace, president of Ohio Contractors Association, Canton, O.
   (d) Discussion—by R. J. Darnell, assistant city engineer, Huntington, W. Va.
   (e) Discussion—by V. M. Peirce, district engineer, U. S. Bureau of Public Roads, Washington, D. C.
2. Highway Research—by Roy W. Crum, director of Highway Research Board, National Research Council, Washington, D. C.

AFTERNOON—1:30 P. M.

1. Brick Fillers and Bedding Courses—by Prof. J. S. Crandell, University of Illinois, chairman of the committee on "Filler for Brick and Block Pavements," Highway Research Board.
   Discussion by P. J. Freeman, chief engineer, Bureau of Tests and Specifications, Allegheny County, Pa.
   Discussion by Luke Savage, city engineer, McKeesport, Pa.
   Discussion by Prevost Hubbard, chemical engineer, The Asphalt Institute, New York City.
2. A Brick Pavement with Metal Base, by Truman L. Flatt, Sangamon County superintendent of highways, Springfield, Ill.
   Discussion by representative of the National Association of Flat Rolled Steel Manufacturers.

7:30 P. M.—Annual Banquet—(Urban Room—17th Floor).

FRIDAY, FEB. 6

SECOND GENERAL SESSION (BALL ROOM)

MORNING—9:30 A. M.

1. Pavement Foundations, by A. T. Goldbeck, director, Bureau of Engraving, National Crushed Stone Association, Washington, D. C.
   Discussion by J. S. Burch, Jr., American Road Builders' Association, Washington, D. C.
2. Brick for Street Railway Paving, by A. Taurman, superintendent, Equipment, Way and Structures, Birmingham Electric Co., Birmingham, Ala.
   Discussion by R. H. Simpson, city engineer, Columbus, O.

AFTERNOON—1:30 P. M.

1. Brick Boulevard Construction.
   (a) Ohio River Boulevard, by E. L. Schmidt, chief engineer, Allegheny County, Pa., Department of Public Works.
   (b) Camp Bowie Boulevard, by T. A. Van Amburgh, vice-president, Thurber Construction Co., Fort Worth, Tex.
   (c) Brecksville Road, by Fred R. Williams, Cuyahoga County Engineer, Cleveland, O.
   (d) Discussion by E. C. Blosser, The Highway Construction Company, Cleveland, O.
   (e) Discussion by George Hockensmith, superintendent, Booth and Flynn Co., contractors, Pittsburgh, Pa.
2. The Clay Products Institute of America, by Professor T. R. Lawson, Rensselaer Polytechnic Institute, president, Clay Products Institute of America, Troy, New York.

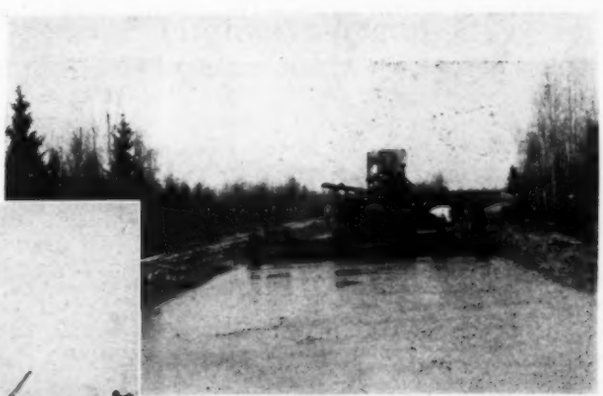
Some MICHIGAN *Projects*

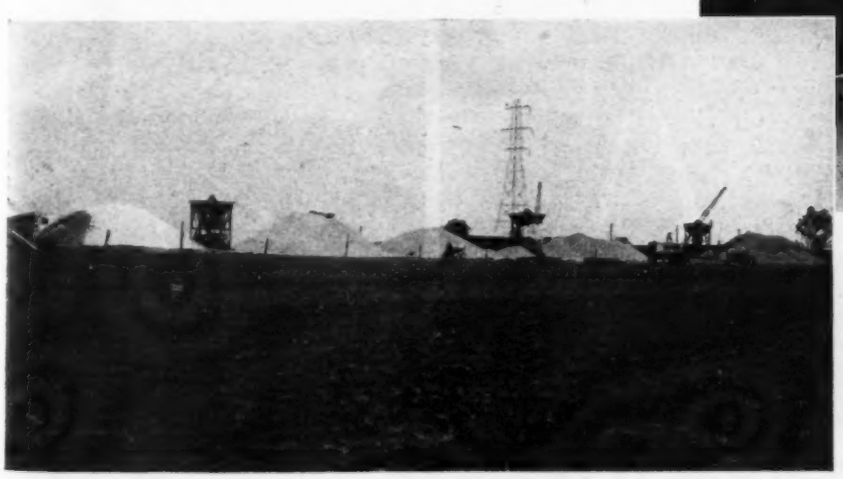
Completed Concrete Pavement in Alger County; Vizenna & Gatiss, Contractors

Pictures from C. M. ZIEGLER
Construction Engineer, Michigan State Highway Department

Placing Concrete Pavement Using Premolded Center Joint, on U. S. Route 27 at Girard, in Branch County; Moellering Construction Co., Contractors

Two Views Showing Dynamiting of Swamp Fill on U. S. Route 27, North of Wolverine; Peterson Construction Co., Contractors





Above—Placing Concrete Pavement on U. S. Route 23, North of Cheboygan; Goldberg Construction Co., Contractors

Left—Proportioning Plant on Paving Project North of Milan, in Washtenaw County, Showing Stockpiles of Separate-Sized Aggregates; Grace Construction & Supply Co., Contractors

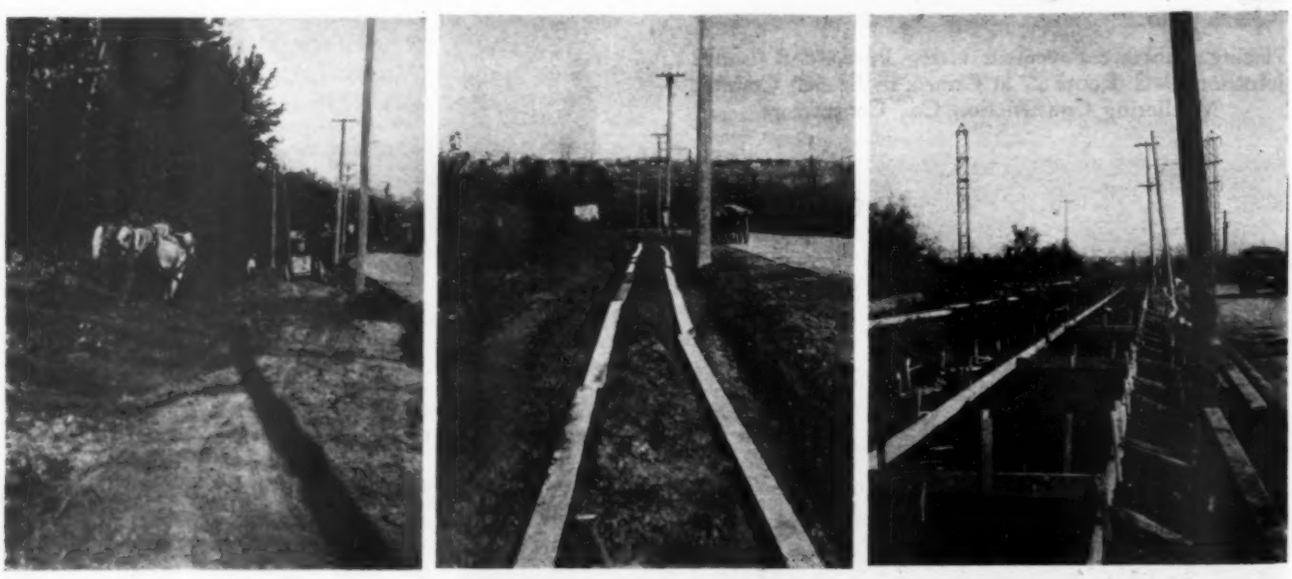
The Asphalt Gang. The Surfacing Material Is Mixed at the City Paving Plant and Hauled to the Job in Trucks

Asphalt-Surfaced Concrete Walks

THE city of Edmonton, Alberta, Canada, has developed a bituminous-surfaced concrete sidewalk which has met with general public approval in that city. The walk consists of a 4-in. base of 2,500-lb. portland cement concrete surfaced with 1 in. of sheet-asphalt mixture. At the annual Asphalt Paving Conference, held Dec. 1-5, 1930, at Memphis, Tenn., A. W. Haddow, city engineer of Edmonton gave the following information regarding this bituminous-surfaced concrete walk.

Method of Construction.—The grading work is done in the usual way with teams and hand labor, by a grading gang, using wagons and scrapers. The fine grading is done by hand labor by the concrete gang, and wooden forms are set to line and grade along the edge of the walk, with spacing boards at intervals of 25 ft. to provide for expansion and contraction. The 2,500-lb. concrete is then poured and the side and transverse surface retaining shoulders 1 in. high are immediately completed.

The sheet-asphalt surface is mixed at the city paving plant in batches containing 1,000 lb. of paving sand, 115 lb. of asphaltic cement (D grade, penetration 58-63) and



Grading and Formwork for Bituminous-Surfaced Concrete Sidewalk



Left—Concrete Work. Center—Ready for Bituminous Surface—Right—The Finished Walk

41 lb. of paving dust filler. This mixture is hauled to the job in trucks, spread in the usual way with hot rakes and consolidated with a 1,700-lb. water-ballasted roller, 30 in. in diameter and 30 in. wide, and portland cement concrete or paving plant dust is dusted over the freshly consolidated surfacing. The street gang, comprising a foreman and 20 men, completes an average of 1,500 to 1,800 lin. ft. of surfacing per 8-hr. day. The total cost of 1-in. surfacing per sq. yd. is 66 ct. Very often the surfacing is not laid for several weeks after the base, but this causes no inconvenience to pedestrians as they use the base.

Costs.—The total cost of construction is 30 ct. per sq.ft. This includes all charges for labor, material, auxiliary work, such as reconstruction or adjustment of other utilities, including hydrants, poles, private approaches, etc., and also a departmental charge for overhead of 5 per cent. This construction is carried on as a local improvement and assessed against the abutting property. For purposes of assessment, the cost of the necessary street and lane crossings is included. These crossings are constructed altogether of portland cement concrete slab, 6 in. thick at lanes and 7 in. thick at streets. This construction, together with the cost of construction interest, debenture discount and flotation charges, is then assessed against the abutting property. The whole season's program, including street and lane crossings involved, is pooled and a unit annual rate set per property foot (or per lineal foot of walk) of 16 ct., continuing for a period of 20 years. On this basis 85.24 miles of this class of walk have been constructed.

Labor and Material Rates.—Some current rates for labor and material effecting this class of construction, are as follows:

Class	*Labor*	Ct. per Hour
Common hand labor		50
Skilled hand labor		52
Team and teamster		95
Cement finisher		80
Asphalt rakers		57
Portland cement concrete foreman		100
Asphalt foreman (per month)		$144.00

	Material
Asphaltic cement	$29 per ton in tank cars, f. o. b. paving plant
Paving sand	$1.75 per cu. yd., f. o. b. paving plant
Concrete sand	$1.90 per cu. yd., f. o. b. paving plant
Coarse aggregate	¾ in. crushed rock $3.40 to $3.75 per cu. yd., f. o. b. job
Portland cement	95 ct. per sack (87½ lb.)

Local Conditions.—The city of Edmonton is the capital of Alberta, and is situated 300 miles north of the International Boundary line, adjoining the state of Montana. It is surrounded by a very fine agricultural and dairy district. The district is also exceptionally rich in natural resources of coal, natural gas and oil.

The soil structure is generally 1 to 3 ft. of rich black loam, overlying brown clay. Rock is several hundred feet below the surface.

The general elevation of the city is 2,200 ft. above sea level and the distance from the Pacific coast in an air-line is 600 miles, with the Rocky Mountains, whose general peak elevation is approximately 10,000 ft. above sea level, intervening. The average annual precipitation is 18 in., made up of 14 in. of rain and 4 in. equivalent of snow. There are wide variations in temperature ranging from 90 deg. F. in summer to 50 deg. below zero occasionally in the winter time.

▼

Traffic Survey of Michigan State Highways Begun

In an effort to determine how much of the cost of local roads in Michigan should be paid by local taxpayers and how much should be spread over the State, the Bureau of Public Roads, in cooperation with the Michigan State Highway Department, is conducting an origin and destination traffic survey on all roads, local as well as main State highways, in sample townships in the 83 counties in the State.

The facts obtained by the survey will show to what extent the local roads of each local taxing jurisdiction are used by traffic originating within and without these jurisdictions; and will serve as a basis for the distribution of public funds now being made available for highway improvement. The survey will also determine the amount of tourist traffic in the state.

This investigation was begun on July 1 and will continue for one year, after which time the same agencies will make special studies for one month, in seven cities, to determine the relative use of city streets by city vehicles and by vehicles owned outside the cities. These studies will also be used as a basis for taxation. The cities selected are Ann Arbor, Detroit, Flint, Grand Rapids, Jackson, Lansing, and Niles.

County and Township Road Field a Continuous Market

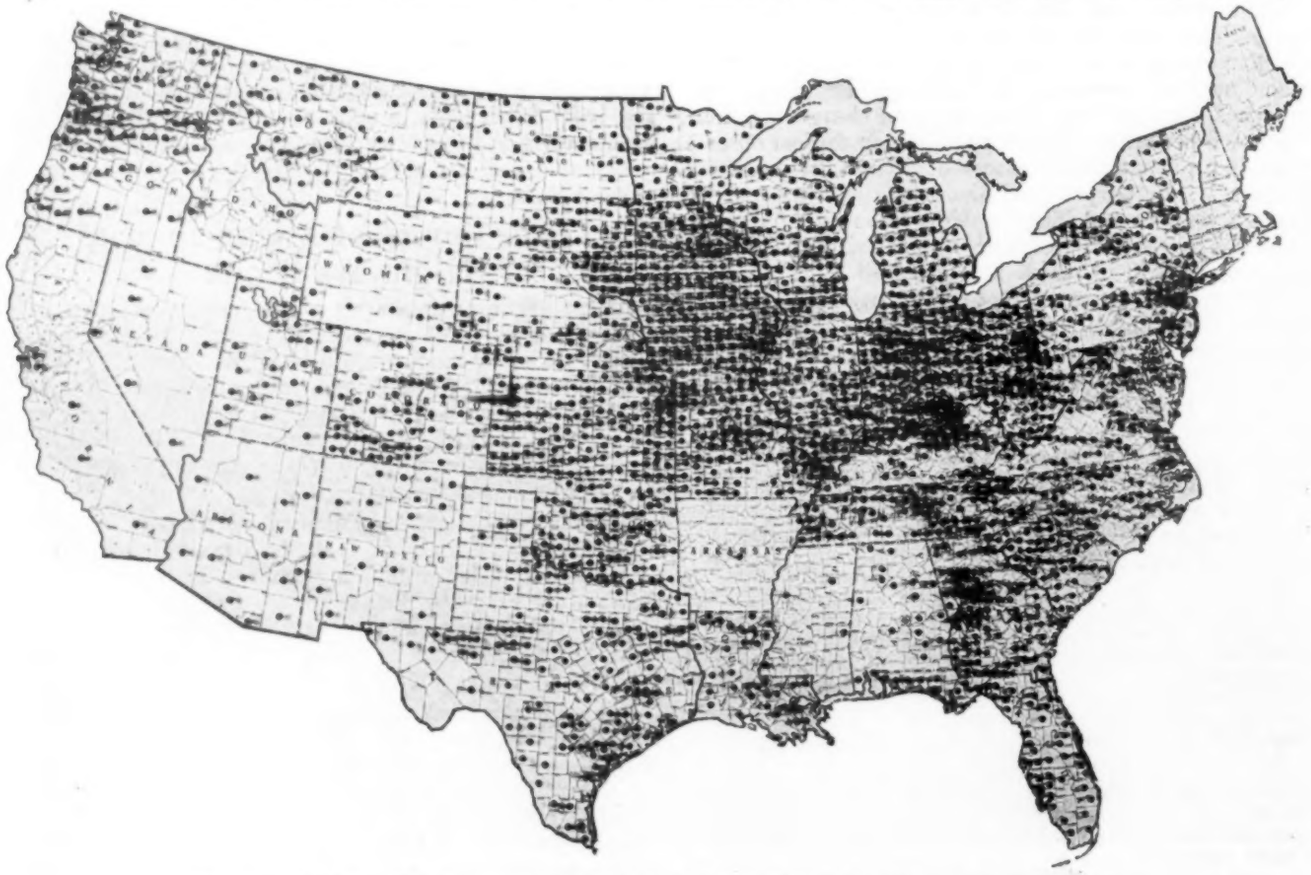
WITH the approach to completion of the primary road systems of the various states, the county and township systems assume greater significance in the development of farm-to-market roads. Many people do not realize the importance of these roads or the magnitude of the expenditures in this field. With this fact in mind ROADS AND STREETS made the survey which follows. There are only 500 counties represented in this survey out of the 3,000 counties which have supervision over road work. Furthermore these are average counties, neither the large nor the small counties predominating. In fact, none of the counties in which big cities are located are tabulated in the survey.

The total probable construction expenditure for 1931 for these 500 average counties is $48,205,260, maintenance $30,737,661 and probable 1931 new equipment expenditure is $4,222,923. This survey checks very closely with a previous investigation made by ROADS AND STREETS in which it was shown that probable equipment expenditures for the entire county and township road field would be $20,000,000 for 1931. This is a conservative figure as can be shown by analyzing the totals given above. For the 500 counties tabulated the total probable expenditure is approximately $83,000,000. The probable new equipment expenditure is $4,000,000 in round numbers or about 5 per cent of the total.

From reliable sources it is shown that the total 1931 probable expenditure for *all* the counties and townships will not be less than $800,000,000. If the new equipment ratio is maintained then an expenditure of $40,000,000 can be expected. Thus it is seen that the $20,000,000 figure developed above is quite conservative.

The table follows:

State and County	Mileage County Road System	Expenditures in 1930 for County Roads			Probable Expenditures in 1931 for County Roads		
		Construction	Maintenance	New Equipment	Construction	Maintenance	New Equipment
		In thousands of dollars					
ALABAMA							
Cleburne	637	28	33	3	25	35	5
Montgomery	800	154	165	25	....	250	....
ARIZONA							
Coconico	800	50	20	15	60	25	10
Greenlee	200	20	31	4	20	31	4
Pinal	400	20	117	22	29	117	25
Yuma	1000	300	60	5	....	75	10
CALIFORNIA							
Fresno	4250	100	700	25	100	700	25
Kern	2959	.....	....	....	197	470	72
Riverside	2200	205	300	45	266	316	30



Counties Having Engineers or Superintendents to Supervise County Road Work

State and County	Mileage County Road System	Expenditures in 1930 for County Roads			Probable Expenditures in 1931 for County Roads		
		Construction	Maintenance	New Equipment	Construction	Maintenance	New Equipment
		In thousands of dollars					
COLORADO							
Chaffen	100	18	9	4	15	8	7
Elbert	2000	60	20	6	60	20	15
Hinsdale	150	3	10	5	5	10	7
Lake	70	5	4	1	20	5	....
Moffat	800	10	40	10	10	40	10
Morgan	900	40	90	20	40	90	20
Sedgwick	800	30	18	6	28	29	8
DELAWARE							
Sussex	2500	125	63	14	75	50	8
FLORIDA							
Hillsborough	1200	100	200	50	30	150	30
Indian River	205	15	25	....	30	30	5
Manatee	350	....	30	....	....	25	....
Martin	275	15	8	3	15	10	....
Orange	565	1226	225	25	75	275	....
Palm Beach	350	100	135	6	75	135	10
Pasco	381	.....	55	....	....	50	....
Putnam	600	80	36	....	30	6	3
Sarasota	189	....	45	....	....	50	....
St. Lucie	422	10	62	2	12	48	1
GEORGIA							
Bacon	400	15	35	1	15	35	1
Gwinnett	1100	100	56	5	75	60	15
Murray	254	45	15	4	85	16	5
IDAHO							
Bannock	917	120	50	9	88	57	1
Clearwater	129	5	6	....	6	....	....
Twin Falls	600	30	20	6	35	25	3
ILLINOIS							
Bond	120	....	20	....	50	20	....
Carroll	105	8	15	1	42	12	2
Crawford	126	12	30	....	65	23	....
Edgar	224	25	16	....	10	30	....
Fayette	280	.....	28	....	.....	28	....
Fulton	372	90	45	15	100	45	10
Grundy	756	31	15	7	65	15	....
Iroquois	300	264	80	10	140	66	....
Jackson	210	5	18	1	49	15	1
Jasper	155	10	5	2	25	5	....
Kankakee	175	7	22	14	125	25	10
Lake	120	300	45	5	500	40	....
McHenry	175	.....	61	5	100	58	4
McLean	245	103	28	....	95	22	....
Macoupin	275	78	18	3	70	20	5
Mason	115	.....	37	....	....	35	....
Menard	97	12	3	....	35	4	2
Monroe	526	6	16	....	21	15	....
Morgan	195	3	50	2	75	40	1
Perry	90	10	3	....	10	5	1
Richland	120	12	2	....	6	3	....
Sangamon	150	250	70	20	300	75	15
Shelby	280	15	25	....	13	30	2
Vermillion	1600	350	25	....	170	25	....
Wabash	380	45	35	....	25	40	....
Wayne	200	12	7	....	30	8	....
Whiteside	1125	41	40	5	30	30	3
Winnebago	250	340	35	5	370	30	3
INDIANA							
Crawford	150	1	25	2	2	24	3
Delaware	781	50	50	11	50	50	10
Fulton	470	12	75	3	15	64	3
Hancock	620	66	14	....	67	8	....
Jefferson	325	70	46	5	50	48	4
LaPorte	490	100	88	12	30	70	9
Miami	580	30	20	....	30	20	8
Porter	475	241	117	12	300	117	11
Pulaski	443	.....	78	6	....	78	4
Randolph	678	212	48	18	212	48	18
Shelby	540	144	87	2	40	85	3
Sullivan	589	10	95	5	10	40	....
Tippecanoe	650	20	90	11	20	80	14
Vermillion	387	.....	57	6	....	50	2
White	540	75	50	5	100	75	10
IOWA							
Audubon	851	63	70	8	70	100	24
Black Hawk	914	145	130	60	100	100	25
Boone	1008	110	95	30	110	110	20
Buchanan	986	65	76	40	75	86	20
Butler	1087	100	90	50	100	120	20
Carroll	140	83	56	12	80	50	15
Cass	995	34	150	18	75	140	20
Cerro Gordo	118	67	40	16	40	40	12
Chickasaw	900	55	85	5	50	80	7
Clarke	711	24	84	21	49	70	6
Clay	140	.....	85	7	.....	75	10
Decatur	885	53	98	18	63	100	20
Delaware	935	92	85	20	90	70	15
Grundy	808	48	100	16	60	90	10
Harrison	140	95	165	20	100	150	30
Howard	742	56	88	15	60	85	12
Humboldt	700	60	70	20	60	80	12
Jefferson	103	65	121	26	65	83	11
Jones	889	115	86	24	130	95	5
Kossuth	1800	147	152	64	152	168	45
Lee	758	96	105	30	90	120	....
Linn	1230	132	229	60	192	169	....
Lucas	703	40	50	22	45	55	15
Lyon	935	52	40	40	90	100	20
Mahaska	1031	97	140	28	97	140	20
Marion	904	82	114	18	80	110	5
Mills	730	45	100	35	45	100	14
Monona	1044	124	91	21	74	95	12
Muscatine	79	88	20	....	86	107	....
O'Brien	116	45	110	25	45	110	10
Osceola	90	57	80	6	58	80	6
Palo Alto	921	120	101	35	100	110	10
Pocahontas	1100	111	81	3	71	111	....
Polk	900	156	189	57	156	189	57
Poweshiek	1023	65	110	30	100	110	20
Ringgold	962	68	69	15	67	65	8
Scott	677	104	102	48	116	90	4
Shelby	920	74	130	35	60	120	30
Story	1011	110	100	40	100	120	10
Union	750	34	86	25	70	55	10
Van Buren	840	52	86	30	52	85	....
Warren	.....	70	140	30	120	120	10
Woodbury	1333	150	200	30	140	185	25
Webster	1102	210	193	....	200	195	....
KANSAS							
Butler	275	70	60	10	60	60	30
Chautaugua	800	41	40	13	37	35	6
Cheyenne	54	17	9	8	25	10	6
Clark	725	25	14	15	25	14	4
Cloud	156	50	35	7	30	25	5
Coffey	134	20	15	....	25	15	4
Cowley	165	217	50	12	135	50	5
Douglas	164	105	19	36	100	18	20
Ellis	100	44	18	7	38	16	10
Ellsworth	131	8	18	5	12	20	6
Finney	860	18	34	2	25	35	3
Franklin	172	87	15	3	75	15	5
Gove	170	21	8	7	21	8	7
Haskell	480	16	10	12	14	10	9
Hodgeman	1100	35	10	6	36	15	6
Jackson	134	14	9	2	26	10	9
Kingman	146	100	30	....	40	30	....
Marshall	286	230	50	14	250	45	20
Miami	1065	182	30	22	80	35	....
Morris	133	22	12	12	25	10	8

State and County	Mileage County Road System	Expenditures in 1930 for County Roads: Construction	Maintenance	New Equipment	Probable Expenditures in 1931 for County Roads: Construction	Maintenance	New Equipment
		In thousands of dollars					
Osage	184	100	20	2	75	25	5
Ottawa	143	13	14	10	18	12	5
Phillips	146	42	17	11	20	16	5
Rawlins	185	18	20	8	15	23	6
Republic	185	34	28	13	45	28	2
Russell	160	30	12	10	25	15	12
Sedgwick	400	350	75	30	300	75	20
Sheridan	135	21	11	....	....	....	....
Sherman	142	11	10	4	14	11	4
KENTUCKY							
Boyle	210	62	50	7	....	....	....
Bracken	260	3	22	3	....	22	....
Clark	320	40	12	4	30	20	10
Clay	150	30	1	5	5	2	3
Grayson	800	2	10	2	3	12	5
Kenton	600	30	130	3	30	130	3
Mercer	300	15	37	....	....	....	....
Woodford	190	....	70	....	....	70	....
LOUISIANA							
Bossier	500	150	50	....	....	50	....
Calcasieu	800	45	115	30	60	120	10
Madison	200	100	90	10	250	15	5
Ouachita	400	120	75	10	100	75	10
Rapides	720	200	75	10	13	90	7
Tangipahoe	400	....	48	9	....	48	5
Vernon Parish	275	....	60	20	50	60	5
Webster	200	15	75	12	15	75	8
MICHIGAN							
Allegan	337	82	64	67	167	60	20
Branch	451	82	66	17	85	70	15
Cass	300	16	76	6	87	80	5
Cheboygan	104	47	33	3	50	30	2
Chippewa	163	55	46	22	78	62	10
Genesee	706	1350	492	65	1000	500	25
Gratiot	265	12	85	4	10	90	....
Hillsdale	257	105	72	8	40	71	10
Huron	256	20	50	10	20	50	10
Ionia	290	60	50	24	60	60	25
Iosco	109	42	13	5	42	13	5
Iron	84	60	28	10	50	30	10
Jackson	425	200	160	25	130	170	20
Kalamazoo	400	166	194	41	150	190	30
Kent	500	600	300	30	500	350	50
Leelanau	....	18	54	26	19	51	2
Livingston	295	76	46	19	30	70	8
Macomb	357	75	180	40	10	150	10
Marquette	101	140	35	20	92	40	10
Ontonagon	108	14	22	21	38	37	20
Ottawa	175	118	105	32	66	124	10
Presque Isle	83	30	8	2	35	20	....
Saginaw	550	443	162	34	250	166	30
St. Joseph	429	79	71	10	6	70	15
MINNESOTA							
Becker	230	70	25	2	80	25	2
Beltrami	412	51	30	8	50	30	10
Benton	190	50	16	5	50	16	8
Cass	471	35	47	3	30	50	3
Chippewa	170	60	32	32	60	35	10
Cottonwood	190	40	25	10	40	30	5
Dodge	152	70	20	5	50	20	1
Douglas	240	93	15	12	75	20	8
Goodhue	250	8	75	13	125	75	....
Grant	200	50	20	3	30	20	10
Hennepin	650	250	350	50	200	340	10
Hubbard	275	67	21	....	31	23	....
Itasca	2054	75	115	20	90	115	40
Kanabec	146	45	12	12	48	14	6
Koochiching	600	35	20	2	30	20	1
Las Quie Parlie	234	89	31	16	90	35	15
Lake of the Woods	222	52	19	6	40	20	5
Lincoln	187	78	28	....	10	28	5
Lyon	318	121	40	7	125	50	10
McLeod	252	59	27	14	75	28	....
Mahnomen	168	40	11	3	42	11	4
Marshall	550	75	35	20	65	35	10
Meeker	500	150	30	8	100	50	10
Mille Lacs	52	20	2	1	22	3	2
Morrison	273	100	20	7	80	22	4
Nobles	300	153	62	5	150	60	10
Norman	100	50	10	17	....	....	....
Otter Tail	530	244	68	24	230	65	25
Pine	340	114	24	17	90	31	10
Redwood	384	57	29	2	50	30	9
Scott	190	80	25	4	80	25	4
Sibley	386	168	58	14	150	50	8
Sherburne	270	30	10	9	35	12	4
Stearns	2390	150	50	23	175	50	10
St. Louis	2800	1000	600	100	1000	600	100
Wright	250	218	25	....	115	25	10
MISSISSIPPI							
Sunflower	950	153	30	8	75	30	8
MISSOURI							
Andrew	720	38	32	1	35	30	8
Audrian	1100	40	20	6	60	28	....
Atchison	196	35	1	....	40	1	5
Bates	1500	50	10	....	100	25	6
Butler	800	15	21	1	12	18	1
Callaway	1230	7	12	1	6	10	3
Clay	750	....	60	7	....	65	4
Cooper	1000	50	30	3	....	....	....
Franklin	1500	30	10	20	20	15	20
Greene	986	36	5	3	40	5	5
Linn	1500	30	20	....	30	....	....
Livingston	100	30	....	....	....	....	....
Moniteau	580	1	2	1	1	2	1
Newton	100	60	15	4	70	18	....
Pettis	1300	180	70	....	75	7	....
Randolph	950	6	28	....	6	28	....
Saline	1200	56	40	16	....	....	....
St. Charles	700	63	60	2	35	60	5
Warren	535	13	12	1	14	12	2
MONTANA							
Chauteau	3000	60	20	18	60	20	20
Dawson	2750	25	30	15	20	40	10
Fergus	2400	58	35	7	60	40	7
Flathead	1628	20	22	18	10	40	10
Judith Basin	1150	27	13	6	17	11	4
Missoula	708	65	21	10	62	20	21
Musselshell	420	....	23	....	....	27	5
Phillips	2100	14	21	2	16	20	1
Ravalli	600	30	30	5	30	30	5
Teton	1076	28	13	5	35	15	5
Toole	1700	15	40	10	15	40	10
Valley	3000	48	14	7	....	....	....
NEBRASKA							
Antelope	210	64	8	14	65	8	5
Clay	1006	25	18	13	25	18	75
Hitchcock	182	....	....	5	....	....	....
Douglas	640	125	75	22	450	100	12
Hayes	950	40	15	6	25	15	4
Otoe	1188	119	29	7	75	25	6
Richardson	160	30	15	5	30	15	....
Sheridan	....	12	8	11	15	8	5
Sherman	115	....	....	....	....	....	....
York	220	40	25	10	135	25	10
NEW JERSEY							
Cape May	122	300	187	2	300	187	2
Hunterdon	149	174	122	6	110	125	8
Mercer	143	152	240	23	150	265	....
NEW MEXICO							
Grant	325	30	30	15	40	30	5
Luna	150	3	5	....	4	6	....

State and County	Mileage County Road System	Expenditures in 1930 for County Roads: Construction	Maintenance	New Equipment	Probable Expenditures in 1931 for County Roads: Construction	Maintenance	New Equipment
		In thousands of dollars					
NEW YORK							
Cayuga	366	163	139	8	200	140	....
Chautauqua	....	600	100	....	600	100	....
Chemung	150	135	35	12	135	40	....
Clinton	185	160	71	39	160	71	25
Fulton	148	65	65	3	65	65	15
Herkimer	350	125	150	25	275	150	25
Lewis	225	180	50	15	200	50	....
Niagara	250	900	120	60	800	150	15
Orleans	85	206	10	5	200	15	8
Oswego	490	247	50	65	247	50	65
Saratoga	201	240	55	23	260	55	20
Seneca	75	80	20	1	80	20	15
Steuben	600	250	175	25	250	175	25
Sullivan	183	214	103	60	220	110	10
NORTH CAROLINA							
Beaufort	572	20	76	6	13	68	11
Buncombe	900	350	40	25	300	40	....
Cabarrus	400	35	50	5	25	52	4
Dare	100	25	1	2	....	....	....
Halifax	654	....	125	5	....	125	5
Henderson	1000	20	50	30	40	50	10
McDowell	284	20	34	....	20	34	10
Mecklenburg	575	180	116	30	180	116	30
Nash	650	40	106	....	30	90	4
Pender	411	2	25	5	3	23	2
Wayne County	847	51	56	8	51	42	10
NORTH DAKOTA							
Burke	240	225	1	2	28	2	5
Grant	500	40	8	40	20	8	....
Hettinger	200	35	14	30	20	....	....
McKenzie	914	20	15	8	30	20	3
Ransom	264	15	5	7	20	8	5
Sheridan	710	17	6	3	23	6	....
Traill	192	31	20	9	40	20	5
OHIO							
Butler	733	241	25	3	275	40	12
Carroll	306	75	40	12	75	50	10
Cuyahoga	....	6500	1100	60	7000	1000	60
Darke	206	....	145	12	....	150	10
Defiance	827	60	80	8	60	80	10
Delaware	831	60	80	....	45	85	5
Fulton	300	20	75	5	20	75	5
Hamilton	750	2138	490	....	2000	450	....
Hardin	386	36	90	4	40	100	5
Harrison	217	80	20	11	55	25	4
Henry	808	291	80	10	....	80	....
Highland	335	20	66	....	15	60	8
Holmes	254	75	65	3	80	65	5
Lake	223	101	75	3	100	80	10
Logan	425	....	100	20	10	100	10
Lucas	500	2050	496	43	1200	500	40
Madison	294	25	75	....	30	75	....
Medina	326	226	86	9	225	90	8
Mercer	304	10	31	40	12	32	7
Miami	453	50	150	5	30	150	15
Monroe	397	....	40	3	....	60	4
Muskingum	415	100	100	6	120	100	5
Portage	350	200	80	10	150	90	10
Preble	202	19	38	3	20	40	7
Ross	326	100	70	5	60	70	....
Sandusky	165	35	145	16	30	125	10
Summit	919	1100	205	24	750	205	20
Tuscarawas	461	203	193	18	122	116	8
Van Wert	210	20	35	4	20	35	4
Warren	250	50	65	20	50	65	20
Williams	330	175	50	11	60	50	10
Wyandot	675	100	180	5	80	180	....
OKLAHOMA							
Canadian	290	12	53	10	15	57	14
Carter	312	36	80	18	56	29	18
Delaware	250	27	10	10	25	11	6
Dewey	227	56	11	5	53	15	2
Garfield	538	100	63	25	31	63	15
Jackson	226	60	40	12	70	35	8
Kay	300	125	80	26	....	....	....
Leflore	2500	114	....	....	....	120	....
Ottawa	250	70	24	13	27	34	8
Payne	249	100	85	25	55	75	20
Pottawatomie	254	66	152	22	61	102	20
OREGON							
Benton	433	123	13	....	100	13	....
Columbia	330	200	44	16	200	50	....
Douglas	1100	165	70	15	300	80	10
Harney	2400	39	27	5	30	25	5
Jackson	1009	160	70	25	150	70	35
Josephine	500	40	25	20	40	25	20
Klamath	1475	130	20	10	140	20	8
Linn	1200	100	300	15	100	300	15
Morrow	1100	110	25	7	10	25	15
Multnomah	660	625	300	39	323	320	12
Polk	540	100	60	5	20	70	5
Sherman	543	38	39	36	30	30	1
Wasco	1300	80	80	25	80	80	15
PENNSYLVANIA							
Cambria	11	....	8	....	7	....	....
Carbon	....	1500	....	....	300	....	....
Clarion	....	....	....	....	....	....	....
Delaware	900	200	10	6	300	3	....
Union	75	235	12	6	250	15	4
Washington	200	100	80	5	200	75	10
SOUTH CAROLINA							
Anderson	1000	110	70	25	110	90	30
Bomberg	600	10	5	5	10	5	5
Beaufort	380	12	12	7	10	12	....
Chester	680	10	60	3	10	65	4
Camden	1200	2	16	....	2	20	2
Darlington	1200	30	45	8	10	55	15
Greenville	5000	350	100	25	200	100	25
Greenwood	1911	30	50	11	10	50	10
Marlboro	675	55	19	9	....	....	....
Orangeburg	1034	45	40	8	45	40	8
York	900	60	40	8	60	40	8
SOUTH DAKOTA							
Clark	480	56	20	8	50	20	10
Codington	224	35	10	4	35	10	5
Davison	260	60	43	12	3	15	....
Douglas	225	45	15	6	25	15	5
Edmunds	212	2	6	10	25	7	7
Grant	154	20	28	7	15	15	5
Gregory	250	47	22	5	50	22	3
Haakon	500	32	13	....	30	12	5
Hamlin	193	24	16	6	30	16	....
Harding	400	15	13	2	13	15	2
Hutchinson	409	101	14	4	90	14	6
Hyde	160	8	3	6	10	4	4
Lawrence	590	30	41	5	30	41	5
Lyman	340	22	12	10	22	12	5
Marshall	315	22	26	5	22	30	5
Meade	758	45	23	7	35	28	8
Perkins	450	42	33	10	40	35	10
Stanley	380	17	5	....	10	5	3
Washington	118	5	1	1	2	1	1
TENNESSEE							
Clay	41	9	....	1	7	3	....
DeKalb	78	5	9	....	....	14	4
Fayette	800	150	75	....	....	50	....
Greene	1500	23	41	10	23	41	10
Hamilton	900	250	100	50	150	150	30
Hardeman	575	400	24	5	400	24	5
Hardin	200	185	11	11	125	15	....

State and County	Mileage County Road System	Expenditures in 1930 for County Roads: Construction	Maintenance	New Equipment	Probable Expenditures in 1931 for County Roads: Construction	Maintenance	New Equipment
		In thousands of dollars					
Knox	1400	260	205	20	100	300	30
Maury	900	10	30	15	10	30	....
Obion	800	40	10	8	60	10	5
Overton	102	18	1	6	18	....	....
Putnam	200	12	....	....	12	....	....
Robertson	1000	10	50	6	10	50	....
Tipton	500	500	35	5	300	40	10
Wilson	625	25	35	6	10	35	....
TEXAS							
Anderson	500	70	20	10	50	16	10
Austin	750	100	60	6	....	60	....
Baylor	497	....	10	....	....	10	....
Bexar	1495	561	15	....	....	....	....
Brown	378	250	150	10	50	50	5
Burnet	450	....	14	1	20	14	6
Cameron	1500	750	100	20	1000	100	25
Childress	600	45	50	7	....	40	....
Colorado	900	20	10	10	425	20	15
DeWitt	1450	125	20	10	75	30	5
Dickens	630	61	79	2	13	30	....
Ellis	1620	173	175	4	....	150	....
El Paso	425	790	140	20	....	135	25
Galveston	310	25	139	11	20	150	10
Kaufman	500	100	20	8	20	15	5
Knox	350	200	8	....	....	8	....
LaSalle	460	300	20	2	350	20	....
Madison	310	40	20	10	75	25	....
Motley	200	....	10	5	....	10	5
Nolan	500	20	10	10	20	10	10
Runnels	780	160	28	8	150	24	....
Guadalupe	1501	123	68	12	110	80	10
Victoria	1200	9	30	....	3	39	....
Webb	500	50	10	4	45	15	2
Wharton	850	145	125	25	175	150	35
UTAH							
Carbon	200	90	40	25	50	40	10
Rich	75	2	1	1	1	1	1
Washington	300	2	5	1	2	5	1
VIRGINIA							
Buchanan	100	20	10	15	5	12	10
Campbell	617	53	17	21	50	35	....
Fauquier	216	60	40	12	60	45	6
Giles	350	20	26	5	25	25	5
Northumberland	325	20	20	4	15	25	4
Princess Anne	250	....	56	12	1	50	....
WASHINGTON							
Chelan	795	176	101	11	20	105	16
Clallam	500	100	150	13	120	190	18
Columbia	546	67	68	6	75	62	7
Douglas	2000	65	20	4	....	60	4
Grant	2100	62	85	6	59	62	1
Island	300	45	30	22	48	35	20
Lincoln	3000	200	100	25	157	87	4
Pacific	154	129	114	15	148	111	18
Skamania	300	45	40	15	65	40	10
Spokane	496	....	91	7	....	91	14
Thurston	950	107	90	11	110	108	10
Walla Walla	1160	60	178	22	60	178	22
Whatcom	899	114	79	19	149	77	15
Yakima	2500	406	200	15	415	190	10
WEST VIRGINIA							
Berkeley	578	40	30	4	50	20	3
Boone	200	175	35	13	....	50	....
Brooke	160	80	20	10	95	15	10
Mineral	300	6	10	5	....	28	2
Tyler	510	175	48	....	65	40	2
Upshur	600	16	20	1	5	15	3
Wyoming	506	20	20	20	25	25	20
WISCONSIN							
Adams	160	20	24	8	10	24	....
Bayfield	125	160	80	20	160	85	21
Burnett	300	115	60	10	115	60	10
Dane	330	1000	250	25	200	200	15
Douglas	333	50	60	4	60	60	15
Jackson	250	80	25	8	60	25	3
Lafayette	300	205	50	12	210	48	10
Manitowoc	85	21	17	25	22	17	30
Monroe	514	122	160	32	122	160	32
Ozaukee	246	42	60	5	240	60	7
Richland	428	246	114	25	....	117	10
Rusk	210	10	18	10	8	10	8
Waupaca	200	38	48	30	5	60	30
WYOMING							
Converse	1200	....	56	8	....	50	....
Laramie	3980	78	4	6	20	30	10
Sheridan	1252	31	23	13	42	25	....

Precautions in Constructing Embankments

The following observations on the composition of embankments and the preparation of embankment sites prior to filling are made in a report of the Committee on Roadway of the American Railway Engineering Association:

When material is placed in embankments by hydraulic methods, the material is usually sand, and results have shown very few failures and little settlement in the completed work. The tendency to wash can be overcome by rip-rapping, paving or sodding. Generally, in excavating a cut, the rock is found in the lower portion, and is removed after the earth has been stripped. To overcome the placing of this heavy material on top of an earth fill, or earth core, the quantity of the earth coming from the top of the cut can be computed and the fill completed to full section for the distance that there is available material. The excavated rock should then be placed as a complete section, in a similar way. If steam shovel and trestle are used, it would be desirable to make the center portion with earth, and the ends of the fill with rock; the reverse arrangement can be made if no trestle is used. It is thought that an embankment having its extremities built of rock would be ideal construction, as the loose stone would serve as large french drains and prevent water from reaching the fill from adjacent cuts.

A complete preparation of the site of operations is desirable before the movement of the major quantities is begun. On sidehill embankment location, the original ground should not have slopes in excess of 1 ft. vertical to 10 ft. horizontal, at right angles to the center-line of the embankment. When slopes are in excess of this, the ground should be stepped or scarified to insure bond with the new material. Surface ditches should be constructed to protect cuts, their distance from the cut to be governed by the depth of cut and character of the soil. Berms at the base of embankments should be ample to prevent breaking under the weight of the embankment. Slopes in cuts and on fills should not exceed the angle of repose of the material used.

Rambling 'Round the Road Show

TYPICAL of former Road Shows, the annual exhibit of construction equipment held at St. Louis, Mo., Jan. 10 to 16, 1931, drew the attention of thousands of interested contractors, engineers and public officials. All kinds of equipment and accessories were on display. There was, however, a noticeable lack of big power shovels, concrete mixers and hoists. There seems to be a trend toward the use of models. The noise and dirty, dusty atmosphere were in evidence this year as in all previous years. A method of changing the air within the buildings would be a welcome improvement.

There were a few new pieces of equipment on display but the general trend seemed to be that of minor improvements on present machinery. One monster truck had two 8-cylinder engines under the hood and was mounted on 10 pneumatic tires. It requires at least an 8-ft. traffic lane in which to move.

Another new piece of equipment was an odorless garbage collector of large capacity.

When the writer passed by the toy scraper in Building B, the first thing that came to his mind was the old saying, "There ain't no such thing." This outfit was a 7-yd. fresno that would roll along on a pair of wheels at the rear after being loaded.

One of the boys playing around Building A evidently left his toy locomotive on the floor. If set on a pair of rails outside the Arena it could have pulled the building apart.

In keeping with the trend of the present-day economic regime, practically every device in the eight acres of show space was a labor-saver. That, of course, entails largeness, mechanical ingenuity, strength, power, stamina and super-craftsmanship.

While most of the space was taken up by the monster engines of road building—graders, concrete batching plants, tractors, trucks and the like—the show abounded with miniature specimens.

In fact, there was a sufficient number of toy trucks, tractors, engines, bridges, rock crushers and shovels to keep any youth with a mechanical mind in happiness until he reaches maturity.

Similarly motion picture and slide projection machinery were not lacking. Many manufacturers, realizing a limited space accorded them in the exhibition rooms might not enable them to give prospective customers an idea of performance, filmed their road machinery in actual use and gave free shows continuously in small booths.

Exhibits which came in for their share of notice were those of the various states and the U. S. Bureau of Public Roads. Those of the states depicted the development of the country and how roads helped in that development while the bureau's exhibit showed by model and picture how different types of highway surfaces were built. The various other activities of the bureau were clearly depicted.

A comprehensive laboratory in scientific road building, reflecting intense research and careful preparation, was contributed by the U. S. Bureau of Public Roads. The display was largely technical, having to do with soil analysis, grade construction, concrete laying, tensile strength, materials and road instruments. There were several miniatures of roads in this group, and those detailing the steps between dirt and hard surface, with a built-to-scale engine model at each link, were of particular interest.

About the nicest thing connected with the road show was the fact that any man could do all the tinkering and examining he wanted to without getting his hands dirty. The engines and devices were either shiny or coated with paint. Red predominated, with battleship gray a close runner-up.

If an award were to be given for the cleverest piece of non-mechanical matter in the show, it would probably go to the Tennessee Highway Commission for its miniature landscape model of Ozone Falls. Built to exact scale from highway blueprints, this scenic masterpiece was a vest pocket counterpart of one of Tennessee's beauty spots. The hard-surfaced highway, "practical" waterfall, railroad and foliage-covered mountain were laid out to perfection on a 12-ft. table. Representatives of the commission insisted there were only one or two minor inaccuracies in the layout; otherwise it was perfect.

Not forgetting the Missouri Highway Commission, it must be admitted that the state's exhibition compared favorably with that of any other area.

In boarded up spaces of the promenade around the Arena were five meeting rooms. Dissatisfaction with these convention rooms was much in evidence. The seats were hard and uncomfortable to the extent that they drove the prospective audiences to other places. Those primarily interested in each proceeding constituted the most of the auditors at each session. Noise from the outside made it difficult to hear the speakers despite the amplifying horns. In one of the sessions at which the equipment committee was giving its report there were not enough present to form a corporal's guard.

The city and county officials' divisions seemed to be the ones best attended. Considerable progress has been made with these two divisions the past year. The county officials' session, while covering technical problems, devoted most of its time to discussions of public relations and regional planning. The features of the city officials' session were the papers on construction and the leadership of discussions that followed. A great deal of valuable information was prepared for presentation to the convention sessions and will become available in published form in separate pamphlets later. Abstracts of many of the papers appear elsewhere in this issue.

By way of diversion, the program committee provided entertainment for each evening. Monday night a smoker was given in honor of the foreign delegates. The crowd was well pleased with the program. Tuesday night was given over to a contractors' supper dance, Wednesday evening to the annual banquet and Thursday to an international reception and ball. The annual banquet was very well attended. Floyd Gibbons, who was the principal speaker of the evening, told of an experience that took him from China to French Morocco over roads of various types. He had the highest praise for the French roads. He concluded his remarks by endorsing the association activity leading toward the construction of a highway linking North and South America.

A gigantic road construction program, financed by the federal, state and county governments in the manner Liberty bonds were issued to finance the world war, was proposed as an unemployment solution at the annual dinner by Charles H. Davis, New York, N. Y., president of the National Highways Association. He proposed that "paper money" be issued against the bonds in the same manner the war financing was done.

Roadside Beautification in Connecticut

Pictures from LUTHER M. KEITH

State Highway Tree Warden

Two Views, Showing an Intersection Triangle in Process of Grading and the Same Triangle After the Completion of a Small Highway Garden or Park

An Area Improved Near the Washington Bridge in Milford and Used as a Resting Place and Picnic Ground. There Are Many of These Locations About the State, and They Seem to Be Appreciated Greatly by the Motoring Public. Picnic Tables and Waste Barrels Are Provided for Each One of These Areas, with Sufficient Parking Space to Take Care of a Limited Number of Cars

This Corner, at an Intersection in the Town of Redding, Was an Unsightly Waste Area. One Picture Shows the Work in Process; the Second After Completion

EDITORIALS

A Suggested Cure for Speeding

"IT is generally known among competent observers that speed limits (fixed by law) have negligible effect upon the speed at which vehicles are operated." With this statement of Mr. Al Parmenter few are apt to disagree, but with his remedy for speeding we are at complete disagreement. He urges adopting the proposed rule laid down by the National Conference on Street and Highway Safety.

The rule as promulgated by the conference is in two parts. Part One, which is called the basic rule, prohibits (a) driving a vehicle "at a speed which is greater than is reasonable and proper," or (b) which is greater than will permit the operator "to decrease speed or stop as may be necessary, to avoid colliding with any person, vehicle or conveyance."

A criminal law based on such a rule would be a law without a definition of what constitutes the crime. Suppose a criminal law were to read: Theft, as the word is used herein, shall mean the taking of property belonging to another where the property thus taken exceeds a reasonable amount.

Under such a law thievery would become a matter of opinion, and we do not hesitate to say that under a law that fails to define a speed limit unlawful speeds are a matter of opinion. Observe two drivers of motorcars, one of whom is about 20 years of age and the other about 50, and note their relative rates of speed as they make a street crossing. The younger driver will usually average a speed fully one-third greater than that of the older driver. Both drivers are presumably using their best judgment as to what is a reasonable speed at a crossing. Let two collisions occur at the same crossing, one in which the young driver is travelling 32 miles an hour and one in which the old driver is travelling 24 miles an hour. Let the drivers come before a 65-year old judge. Harking back to days of 15 or 20-mile speed limits, the judge may find both drivers guilty of unreasonable speeds. On the contrary a young judge, himself addicted to very fast driving, may find neither of the drivers guilty. In short, a driver would never know whether his opinion of reasonableness as to speed would be the court's opinion, to say nothing of whether the court's opinion would be sustained by an upper court. As a device for fostering endless litigation nothing could be better conceived than a law that fails to define clearly the forbidden act. There is utter absence of clearness of definition wherever the word "reasonable" qualifies the act, for no two men have exactly the same conception of reasonableness.

In previous articles we have suggested the universal use of speed regulators on all motor vehicles, the regulators being so devised as to enable the driver to turn a switch that will limit his vehicle to the speed prescribed for the zone in which he is travelling. Then if a dial on his car makes visible to traffic officers the speed limit under which his car is operating, slight desire would remain to break the speed laws. Because of the lack of such automatic speed regulation and the fewness of traffic officers, drivers have ceased to obey all speed laws. The remedy for speeding is certainly not in a law that makes each driver his own interpreter of the law. It lies in retaining definite speed limits and enforcing them. To enforce the speed laws without resorting to the use of automatic speed regulators has been impracticable because of the expense of policing the roads and streets. Automatic stop and go signals have been very effective. By analogy, automatic speed regulators should be equally effective, for in both cases disobedience is readily detected and it is, in fact, evident to any user of the highway. Public opinion would thus become as adverse to ignoring the speed requirements in each zone as it is now adverse to riding past a red "stop" lamp.

It has been said that accidents per 1,000 of motorcars are no more frequent in states that have no fixed speed limits than in states that have. Granted all that this proves is disobedience of speed limit laws. So long as one accident occurs annually for every 25 motorcars, and one death for every 32 accidents, there is call for some radical change in the regulation of traffic on our highways. This applies to Connecticut, Michigan, Indiana and Kansas, with their vague laws as to "reasonable" speeds, as well as to the states with specific laws that are not enforced.

H. P. Gillette

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Stabilizing the Construction Industry

WITH millions of dollars worth of trade paper on the books of single manufacturers supplying machinery to the construction industry, it would seem that any action taken toward stabilization of the industry would be beneficial economically for the public in general. Partial default on those individual promissory notes has an immediate depressing effect upon the manufacturers concerned. This effect is rapidly recorded on the factory forces and thus transferred to the butcher, the grocery man, and the general public. Manufacturers, in the rush of competition to make sales, are inclined to lose sight of the consequences impressed upon the industry and the general public when units of equipment sold must be reclaimed because the commercial paper has proved to be worthless.

The fault, however, does not lie entirely with the manufacturer. It is traceable back to two other sources as well, viz.: the contract awarding power and the contractor. Perhaps the most important side of this construction triangle is the contract awarding power. If he should insist that contracts be awarded to the "lowest *responsible* bidder" he will have taken a long step forward toward stabilization of the construction industry. Had this idea been enforced on all contracts during the past four years, some manufacturers now holding disproportionately large sums of worthless trade paper would be in a much better financial condition than they now find themselves, and the public, generally, would be that much more prosperous.

Responsibility of the bidder, then, becomes of paramount importance to the contract awarding power. This power may be a public official, engineer, architect, or owner. If the criticism of these men for the disregard of the responsible and competent contractor is to be justified then the demand of those responsible in the

award of public and private construction contracts must be recognized by the responsible and competent contractor as to his performance record, credit standing, etc., to enable contract awarders to support their decision in the award of a contract to "the lowest *responsible* bidder," not necessarily the lowest bidder.

The answer to the above demand from the awarding officials was the organization of the Bureau of Contract Information, Inc., a non-profit making, fact finding institution whose primary purpose is to gather the performance record of the contractor so that it may be available to those awarding contracts. With it they may be able to select the contractor whose record of performance is clear, has nothing to hide or cover up, and is responsible so long as he undertakes work within his limitations.

In building up these records of performance, the bureau is receiving the cooperation of the awarding officials throughout the entire country, in not only giving verification on the contractor who is voluntarily giving the information for their benefit, but also on contractors whose records they are compelled to build up without the cooperation of the contractors concerned. This latter is an important activity. The responsible contractor of skill and integrity should welcome the opportunity to file his performance record. The fact that he may have defaulted on a contract in the past should be no bar to his willingness to cooperate with the bureau. So long as he works within his limitations he need have no fear that the bureau will be inimical to his interests.

In addition the bureau is receiving from awarding officials notices of the award of contracts and defaults where they occur in the performance of the contracts. It is also receiving from surety companies, notices of contract bonds as written, claims filed under existing bonds, and notices of defaults in performance of contracts.

To date, within 14 months of the organization of the bureau, more than 3,700 contracting concerns throughout the United States who are proud of their records and desire to cooperate in the elimination of conditions which are robbing them of legitimate work, have filed their reports so that the awarding officials may segregate the responsible and competent from the irresponsible and incompetent.

The investigation of the above number of records has involved the investigation of over 40,000 individual construction projects. This has entailed, according to the director of the bureau, over 180,000 verification inquiries which does not include a large number on contractors who have not voluntarily filed information with the bureau.

From the above one will realize that the bureau is receiving cooperation from those recognizing the need of such an institution. The bureau, of course, does not expect the voluntary cooperation for the stabilization of the construction industry from the contractor who knows he is irresponsible because he is undertaking work beyond his limitations or has something to hide or cover up.

Sales of construction equipment to such contractors can lead but to worthless paper when the manufacturer lets down the bars and accepts "a low down payment and notes for the balance." Stabilization can thus be seen to be the problem of the entire construction industry.

Like the necessity of the three sides of a triangle being joined together at their points of contact to form a definite object, thus the activities of the three sides of the construction triangle must unite at their points of contact, to form an improved economic condition in the industry. This definite object is closer to realization through coöperation with the Bureau of Contract Information.

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Lend Helping Hand

DURING the discussion at one of the sessions of the county highway officials' division at the recent annual convention of the American Road Builders' Association, a plan to help the farmer or rural resident help himself get an all-weather road was presented by Joe Long. The gist of this plan is tersely brought out by the following points:

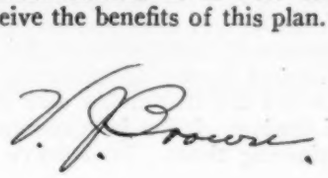
1. Revolving fund.
2. Loaned to special district without interest.
3. Payments back spread over period of years.
4. Payments collected on tax rolls.
5. Revolving funds to be established in counties.
6. Sources of funds to be determined later; suggest, unclaimed bank deposits, unclaimed estates, state aid.

This plan was presented fully in ROADS AND STREETS for October, 1930, page 371.

After Mr. Long presented the plan no further action was taken until the afternoon when resolutions were presented and a summary of the discussions made. It was Mr. Long's desire to have this plan included in the resolutions but that committee did not see fit to include it, probably because of lack of knowledge of the plan and also because the resolutions were hurriedly drawn up prior to the meeting. If resolutions mean anything or have any weighty bearing upon a situation then plenty of time should be taken to formulate those resolutions. They should be prepared by a resolutions committee prior to opening the convention by reference to papers prepared for presentation to the convention. Need for altering them can be seen as the proceedings develop. In this way closer attention can be paid to details and a set of resolutions will result that will have considerable value.

Action taken at the closing session resulted in a motion, which carried, to the effect that a committee of five be appointed to study the plan and report at the next convention. This committee is to be composed of members from various parts of the United States. No doubt this committee will call on Mr. Long to explain his plan in detail to them.

Proper enabling legislation would have to be passed by the various states and no doubt this committee, in its studies, will make recommendations as to how each state may proceed to receive the benefits of this plan.



County and Township Roads

A Section Devoted to the Interests of Those Responsible for Secondary Road Improvement

Portion of Sangamon County Experimental Road

Illinois County Studies
EXPERIMENTAL ROAD

Sangamon county experiments with cheap surface for secondary road system—Various quantities of oil and gravel applied to surface—Preliminary and maintenance operations—Costs—Results warrant continuation of method

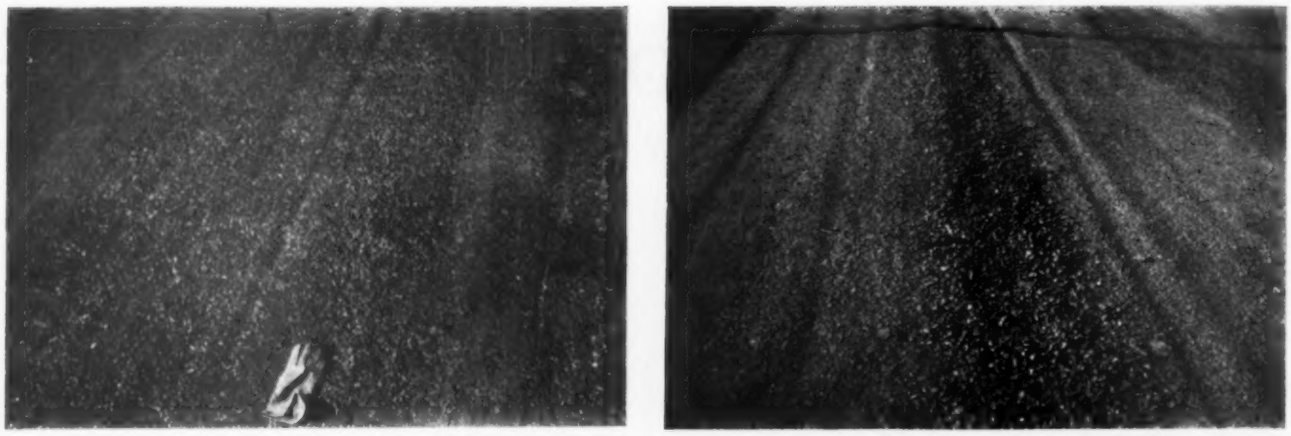
By TRUMAN L. FLATT

County Superintendent of Highways, Sangamon County, Ill.

SINCE the passage of the gasoline-tax in 1927 in Illinois the Sangamon County highway department has devoted considerable thought to the possibility of a cheap surface for its secondary road system. There are a great many miles of oil-treated roads in Sangamon County that give approximately 80 to 90 per cent service, and are worth all that they cost the people of our county to build and maintain. Yet there are certain times during the year that the oil-treated roads do not stand up under the heavy traffic that is imposed upon them.

There is in our country, a considerable number of miles of road that we will never be justified in surfacing with concrete or brick, yet these roads are of enough importance locally that they are deserving of a better surface than we have been able to give them with road oil. The traffic on these roads would not be great enough to justify other than a nominal amount for a wearing surface. With this thought in mind, an effort has been made to develop a cheap surface that will stand up under the traffic imposed upon it, endure under the freezing and thawing of our winter climate and be of such low cost that a considerable number of miles can be built each year.

Selection of Experimental Road.—In choosing a site for this experimental road, care was taken to select a road that would be subjected to the maximum of country traffic, and be close enough to Springfield to permit



Left—Close-Up View of Gravel Surface. Right—Texture of Gravel Surface Where All Material Has Not Been Completely Absorbed in Road Surface

of easy, convenient observation and supervision. As a result the first 5 miles of the highway known as the Old Jacksonville Road were chosen. This road adjoins the city of Springfield on the west and runs in a westerly direction into a community that creates considerable traffic for it.

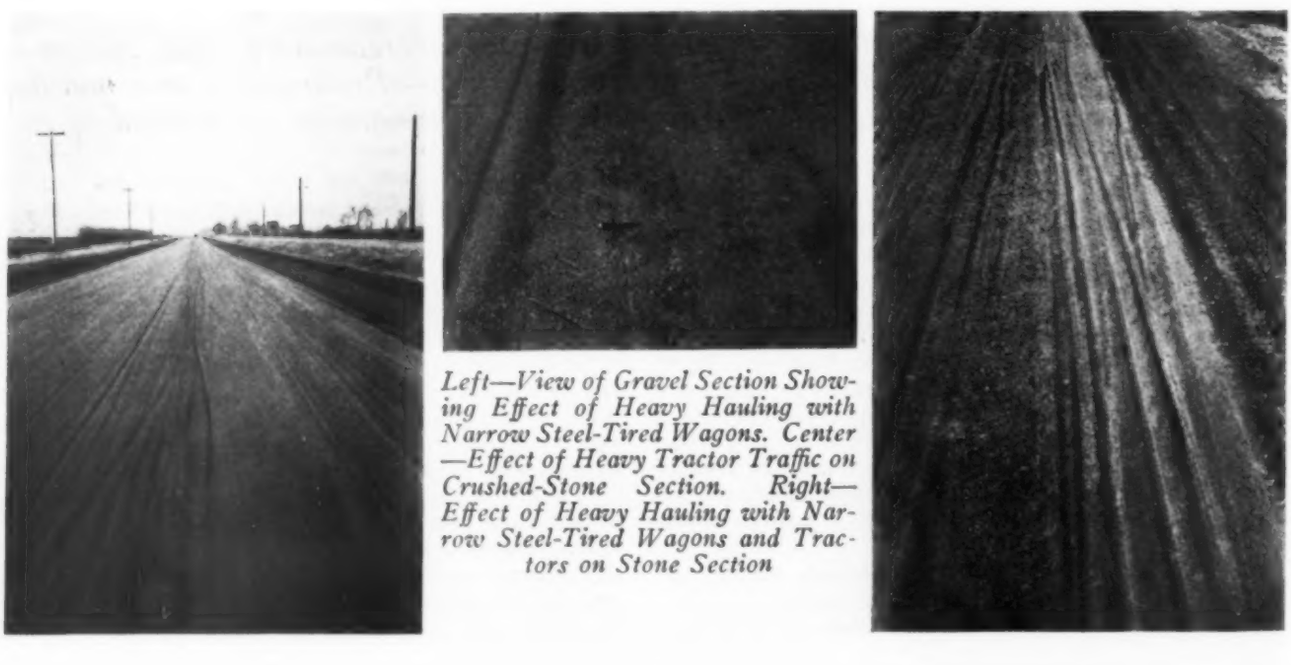
This particular highway had received an oil treatment for the preceding five years, and was in fairly good shape, with one or two exceptions, the old oiled surface showing a penetration of 1 to 3 in. of oil. Before any work was done on the experiment, the side ditches were opened and the drainage of the entire road was corrected so that there was no stoppage of water along the road. In building an oil-surfaced road, it has been found by experience that it is essential to have a fairly high crown, but in building the experimental road, it was thought that a crown of 6 in. would be sufficient.

Preliminary Operations.—An effort was made to reduce the crown of this road to not more than 6 in. This was accomplished by opening the ditches and building up shoulders with a blade grader. After this was done and traffic had consolidated the road, a light coat of E-3 road oil was applied, more to keep down the dust and preserve the existing surface than for any other reason.

The road was surveyed as to length, profile and cross-section so that accurate information could be had in connection with the results obtained. The total mileage was divided into ½-mile sections, numbered and marked with white posts on the north side of the road. After the preparation described above was completed, rock and gravel were delivered on the job to the various sections in the quantities for each section as follows:

Section	Quantity in Tons per mile	Material
1	204	Gravel
2	204	Gravel
3	153	Gravel
4	138	Stone
5	102	Gravel
6	93	Stone
7	153	Gravel
8	138	Stone
9	102	Gravel
10	60	Stone screenings
11	93	Stone
12	102	Gravel

This material was windrowed along the side of the road outside of that portion to be treated in such a way that it would be an easy matter to pull it over the road surface when required. The next operation was to oil the road surface and apply the road material already distributed along the road.



Left—View of Gravel Section Showing Effect of Heavy Hauling with Narrow Steel-Tired Wagons. Center—Effect of Heavy Tractor Traffic on Crushed-Stone Section. Right—Effect of Heavy Hauling with Narrow Steel-Tired Wagons and Tractors on Stone Section

Left and Right—Views of Gravel Section on Hills. Center—View of Crushed-Stone Section, Showing Complete Absorption of Material in Road Surface

Application of Oil.—In Section 1, which is the first section adjoining the pavement out of Springfield, an initial application of ½ gal. of E-3 road oil was made. Immediately after the application of this oil the gravel along the side of the road was pulled up on the oiled surface and distributed in an even layer over the road. This was done by using a 15-ft. blade maintenance machine and a 3-ton truck.

The amount of oil used in gallons per square yard of surface, is as follows:

Section	Gal. per sq. yd.	Section	Gal. per sq. yd.
1	1.075	7	0.810
2	0.717	8	0.496
3	0.831	9	0.511
4	0.784	10	0.541
5	0.484	11	0.383
6	0.517	12	0.383

All of the oil used conformed to the state specification E-3 for road oil, with the exception of one car of Standard No. 6, used on Sections 7, 8, 9 and 10. This is equal to the Illinois specifications for the upper limits of E-3 road oil, but really is a reduced-pressure tar oil with specific viscosity of 28.

Maintenance Operations.—After the work as previously described was completed, intensive maintenance was used. It was the function of the maintenance man to keep the loose gravel and stone pulled back on the surface of the treated road after the traffic had thrown or worked it out to the side. Because some of the material had worked out to the side of the road on to the shoulders and because the maintenance man would get some of the dust or dirt from the road shoulders on to the road surface, there was some dust developed that was quite objectionable. I believe that this could be entirely avoided by making the crown of the treated surface small enough so that material would not work out on the roadside so rapidly.

Road Subjected to Severe Weather Conditions.—During the winter of 1929-30 this highway was subjected to severe winter conditions, and snow drifted to the depth of 5 or 6 ft. in various places along the road. When melting, this snow softened the road surface to a considerable extent. This condition was augmented by the circumstance that the ground was not frozen when the snow and drifting occurred.

Present Conditions of Road.—A recent examination of this road disclosed the fact that it stood up remarkably well with two or three exceptions. These exceptions were on hills. On Section 11, where considerable snow drifted, the services of a Monarch 75 tractor, and a large Baker snow plow were required to go through the drifts. In doing so considerable of the surface of the oiled road was disturbed by the snow plow, and where that occurred there has been a softening of the surface which has caused large ruts to form under the heavy traffic of this road. The other portion of the road shows a fairly good condition at the present time.

It will be noticed from the quantities of material used in this experiment that the greatest amount of material used would be equal to about 1 in. in depth, this ranging down to ½ in. in thickness. It was not the thought that by this treatment a durable all-year surface could be built and maintained in one year. It was thought, however, that by this treatment, carried on for a period of three or four years, enough material would be placed upon the road to insure a foundation of sufficient strength to carry the traffic of the secondary system of roads. When a satisfactory foundation has been built to carry this traffic, it is thought that a bituminous surface built along the lines of the retread method would assure the public of an all-year road.

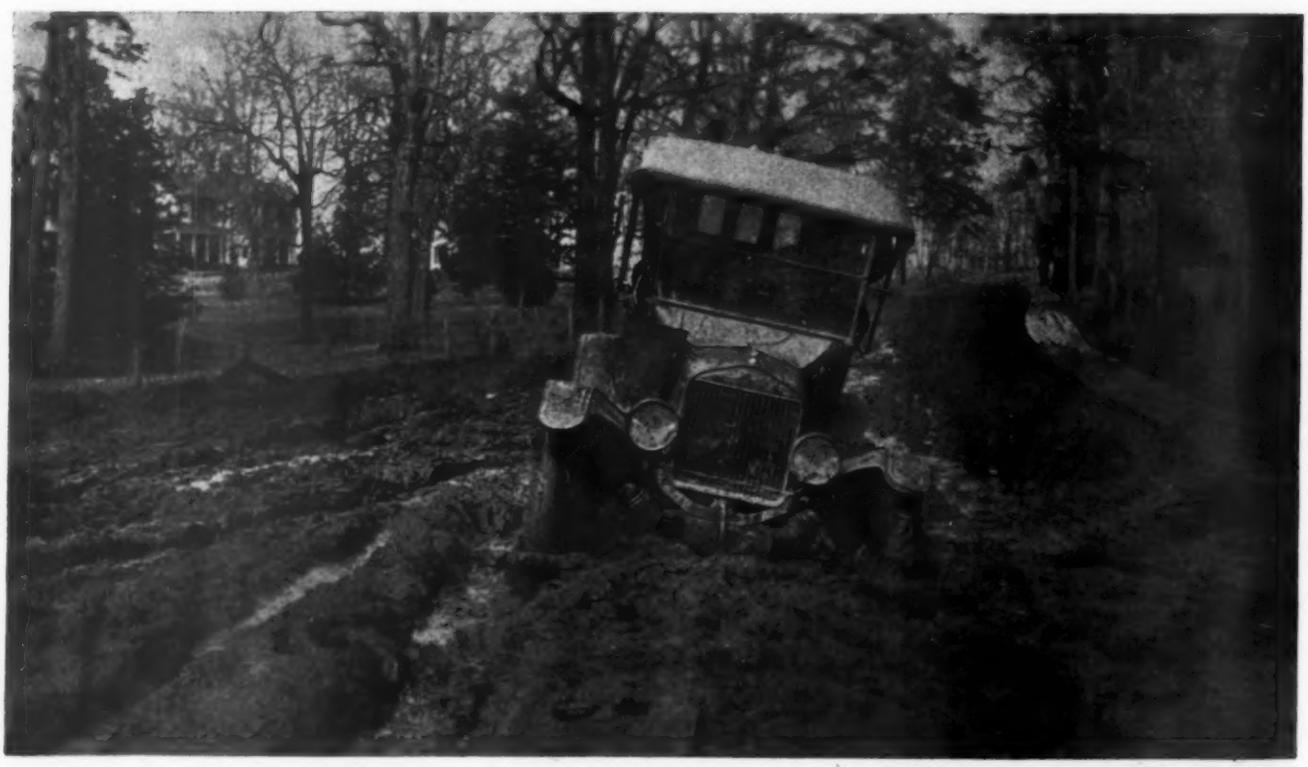
The results obtained so far from our experiment lead us to believe that a continuation of this method would be very beneficial to the road surface, and as the cost is not excessive, it is believed that this could be carried on quite extensively with considerable benefit to the highways.

Costs.—The cost per mile of road on each section runs about as follows:

Section	Cost	Section	Cost
1	$1309.50	7	$1108.68
2	1127.96	8	907.12
3	994.70	9	732.00
4	994.36	10	729.70
5	627.68	11	566.66
6	644.20	12	566.82

BEFORE

A typical spring scene on a Virginia soil road before the surface was given bituminous treatment



Approaching Halifax, Va., on this road was a hazardous undertaking before treatment was applied

AFTER

This is the same road as the one shown directly opposite. A bituminous surface treatment made the difference

Entering into and departure from Halifax have been rendered painless by a bituminous surface treatment

Highway Maintenance Organization *in Woodbury County, Iowa*

By J. C. McLEAN

County Engineer, Sioux City, Iowa; President Iowa State Association of County Engineers

A year ago last January, control of the township road system of Iowa, consisting of 83,250 miles of rural highways, was placed in the hands of the county boards of supervisors. This change necessitated on the part of the various counties of the state, a complete reorganizaion of their road departments. Of the new mileage taken over, 91.28 per cent was unimproved. Funds to be made available had not been materially increased, so that effective construction and more particularly maintenance work could be secured only through careful planning. How the maintenance problem under the new conditions was handled in Woodbury County was told by J. C. McLean in a report presented Jan. 14 at the convention of the American Road Builders' Association.

THE plan to be outlined is applicable to the maintenance of earth, gravel and sand-clay roads such as are met with on the greater portion of the secondary road mileage of Iowa. In the order of their development in the report, the subjects to be treated are:

1. Preliminary fact-finding survey.
2. Assembling survey data.
3. Application of survey data.
4. Other considerations affecting maintenance plan.
5. Field maintenance organization.
6. Summary of conclusions.

Preliminary Survey

In order that a more intelligent appraisal could be made of the whole secondary-road situation in the county, a detailed survey was made in the fall of 1929, covering all of the roads in each of the several townships. This survey was intended to furnish complete information with reference to our newly acquired roads, with the idea in mind that the data thus collected, could later be assembled in readily usable form, and serve as the basis upon which to plan the secondary-road construction and maintenance program of the county for 1930.

The information obtained in the field was listed under the following headings:

1. Inventory of tools, equipment and supplies belonging to each township.
2. Location, type, size and drainage area of all bridges and culverts.
3. Location of all rural routes operating out of the various towns in the county.
4. Location of consolidated schools, the number of buses operating and the routes over which they travel.
5. Location of houses, rural schools and similar improvements.
6. Roads vacated or partially vacated, or where conditions were such that the roads could not be traveled.
7. Bridges or roads requiring immediate or special attention.
8. Classification of roads. For the purpose of the survey each mile of the township road system was considered as a unit and given a classification as either A, B or C.

Class A roads (good roads) are defined as roads which have been recently graded and on which the drainage structures are in good shape and side ditches open. Shoulder width will vary between 20 and 30 ft., clearing, grubbing and widening have been taken care of and their general condition is such that no further work will be required on them during 1930 other than surface maintenance.

Class B roads (fair roads) are those roads which may have been graded or partially graded and widened out, varying in shoulder width between 12 and 20 ft., on which better drainage is needed, and further grading and widening, or perhaps additional clearing and grubbing.

Class C roads (poor roads) include those roads on which no appreciable amount of grading has been done, with shoulder widths varying from 8 to 12 ft., which are poorly drained and perhaps poorly cleared.

Assembling Survey Data

Upon completion of the field survey, the information obtained was made available for further reference through the medium of card indexes and maps.

Inventory of Tools and Equipment.—The equipment inventory is carried in card-index form with entries made showing the type, condition, age initial cost, present value and other pertinent facts with reference to each piece of equipment.

Bridge Map.—The bridge record for field use is made up in the form of a map covering each township in the county, on which all of the structures are shown numbered consecutively. As a means of identification of each bridge, a tabulation is carried on the reverse side of each map showing the bridge number, type and size. Two supplemental records are kept for office use: one

in card-index form giving detailed information with reference to each structure; the other in the form of a classification summary sheet, made up on the first of each year and showing the number of each of the various types of structures in the county.

Road Condition Map.—The road condition record is made up for each township in the county in the form of a map, on which is shown graphically by means of various legends and colors all of the information taken in the survey other than that pertaining to equipment and bridges.

Application of Survey Data

From a study of the information collected on our survey, we were able to reach definite conclusions with respect to the following:

1. Those areas requiring continuous maintenance and those on which intermittent maintenance would be satisfactory.
2. Those areas on which heavy power maintenance would be needed.
3. Those areas where light power or team maintainers could be used, and an outlet thus afforded for the township equipment which was taken over.
4. The mileage of road in need of heavy grading and widening, and those miles where a light ditch cleanout and shaping of shoulders would be sufficient.
5. Bridges and culverts requiring repairs, points at which further drainage would be needed, channel changes, widening and raising of grades and work of a similar character.

Other Considerations Affecting Maintenance Plan

The lack of adequate funds which could be made available for maintenance work was no doubt one of the principal factors which entered into the shaping of the secondary-road maintenance program. This condition necessitated a frequent readjustment of our plans, so that the pattern would more nearly fit the cloth, and available funds would be used to the best advantage.

For the year 1930 the budget provided the amounts shown:

	Total Funds Available	Unit Allotment per Mile
Trunk roads	$ 56,295.15	$429.73
Local roads	144,299.89	124.93
	$200,595.04	

The mileage of roads in the secondary system had an important bearing on our plans, which the survey report shows as follows:

Mileage local roads:	Total mileage	1,199
	Roads closed	44
	Net mileage	1,155
Mileage trunk roads		131
Net mileage secondary system		1,286

A study of the road classification summary, which indicated over 80 per cent of our local road mileage in the B and C classes, led to the inclusion of a greater number of heavy grading and team outfits in our organization than would otherwise have been the case. The classification record at the beginning of 1930 was as follows:

LOCAL ROADS

	Miles
Class A, good roads	232.13
Class B, fair roads	824.42
Class C, poor roads	98.45
	1,155.00

TRUNK ROADS

	Miles
Roads surfaced with macadam, gravel, sand-clay or shale	78.3
Roads built to permanent grade	13.9
Roads not built	38.8
	131.0

A considerable portion of the equipment taken over by the county from the township consisted of items which, because of their age or obsolescence, were not well adapted to maintenance work. The necessity of using as much of this equipment as possible was apparent, so that a careful sorting was made, and such pieces as were usable were reassigned to the various patrol areas. The balance of the equipment was disposed on such terms as were obtainable chiefly through the medium of "trade-ins."

All of the county equipment had been kept modernized and in a state of good operating efficiency. The new addition to our road system presented merely the problem of reapportioning this equipment on an equitable basis, selecting the various pieces that were suitable for the patrol areas under consideration.

Field Maintenance Organization and Equipment

As a preliminary step in working out our maintenance organization, a maintenance map was made dividing the county into 22 patrol areas. Selection of the size and shape of these areas was based largely on the considerations heretofore named. Each area was given a number, and all of the surface maintenance within the individual area is handled by either power or team patrol.

Types of Equipment.—Approximately 65 per cent of the total mileage of roads of the county is under continuous or heavy maintenance with power patrols. These machines vary in size, weight and horsepower according to the topographical conditions, amount of traffic and types of soil encountered. Surface maintenance on the balance of the system is of the intermittent type, where light horse-drawn maintainers are used.

Power Patrols.—Power patrols are assigned from 60 to 75 miles of road, based on a daily coverage of 25 to 30 miles on earth surfaces, and from 30 to 40 miles on gravel. A patrol route map is furnished each operator on which his route is designated as "first day's run," "second day's run," etc., so that he will follow in the order indicated the various routes. These runs cover in their relative order of importance, all of the roads in the area, with a definite mileage assignment on each. The trunk roads are all under power maintenance, and all mileage of this type is included in the "first day's run" in any area.

Team Patrols.—Team patrols have been assigned to that mileage of roads where the condition of the road itself, finances, traffic and other considerations would not permit the employment of continuous heavy maintenance. Each of these areas is subdivided into patrol routes, which are given an alphabetical designation, vary in length from 6 to 10 miles and are maintained intermittently.

Maintenance Districts

For the purpose of maintaining structures and culverts, the 22 patrol areas are grouped into four districts consisting of from five to six patrol areas per district. A bridge crew is assigned to each of these, whose duties consist in the repair and upkeep of all structures in their respective districts, the placing of culvert pipe and work of a similar character.

Heavy Blade Grading and Widening.—Heavy blade work is carried on continuously during the season with

large tractors of the crawler type and blade graders, with one outfit assigned to each district. This equipment covers a definite mileage schedule which is laid out from the condition maps of the district. By this means it is the plan to gradually raise the condition ratings of our roads from "poor" to "fair," and from "fair" to "good."

Light Blade Grading and Reshaping.—Following the power and team patrols are lighter tractors of the crawler type with smaller graders, one outfit operating in each patrol district. This equipment is on a schedule which provides for a complete clean-out of ditches and reshaping of shoulders on all of the mileage of the secondary system once every two and a half to three years.

Snow Removal.—As far as possible, all roads of the trunk system and local roads of major importance are completely protected with snow fence. Light snow-removal operations are carried on by the individual patrolman, while severe conditions are handled with truck and tractor plows, stationed in and operating over the entire maintenance district.

Miscellaneous Work.—The erection and storing of snow fence, clearing and grubbing, building of guard rail, changing of channels, raising of grades and work of a similar character which is too extensive to be handled by the patrolman is performed by special crews operating under the district or gang maintenance plan.

Purchase of Supplies.—The season's requirements of all items used in quantities for maintenance work such as lumber, piling, nails, tools, oils, gasoline, grease, paint, etc., are anticipated in advance. Purchases are made under competitive conditions and allotments made to the maintenance districts early each season.

Contract Maintenance.—The excavation, loading or hauling of surfacing materials, major bridge repairs and work of a similar character requiring a special or large equipment outlay is contracted and let to the lowest responsible bidder.

Summary of Conclusions

Our observations during the past year suggest strongly the following conclusions:

Inadequate funds make necessary the more careful planning of the whole maintenance procedure.

Lack of definiteness in orders and fixing responsibility, and failure to lay out and provide sufficient work for the full employment of time are primary causes affecting the efficiency of maintenance crews.

The use of power equipment for surface maintenance will increase, tending more and more to displace horse-drawn vehicles.

The possibilities of a further extension of contract maintenance covering both labor and materials should be investigated and comparisons of cost made upon which to base conclusions.

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Counties and State Cooperate in Snow Removal in North Dakota

In view of the population served North Dakota has a comparatively extensive state highway system. Its system of 7,500 miles serves a population of less than 700,000 and as a result the traffic on many roads is light. Snow removal under these conditions presents somewhat of an economic problem. The state's first attempt at snow removal was undertaken during the 1928-1929 season and at the beginning of the next season a definite snow removal program with county cooperation was adopted. This plan was outlined by H. E. Fowler, assistant maintenance engineer, in the October *Highway Bulletin* of the state highway department.

There are approximately 7,500 miles of roads in our designated state highway system. Of this mileage, 4,364 miles were constructed and transferred to the Maintenance Department up to January 1, 1930. Maintenance funds are expended only on the constructed portions of the state highway system, other than that of marking all designated routes. At the beginning of the 1929-1930 season, the state highway commission adopted a definite snow removal program. The state owned equipment was assigned to keep open and its operations limited to 1,205 miles of the most important and heaviest traveled routes.

Cooperation with Counties.—On an additional 1,406 miles next in importance, the commission offered to cooperate with the counties to the extent but not to exceed $25.00 per mile for snow removal work during the season, and on the remainder of the constructed portions of the state highway system to the extent but not to exceed $10.00 per mile.

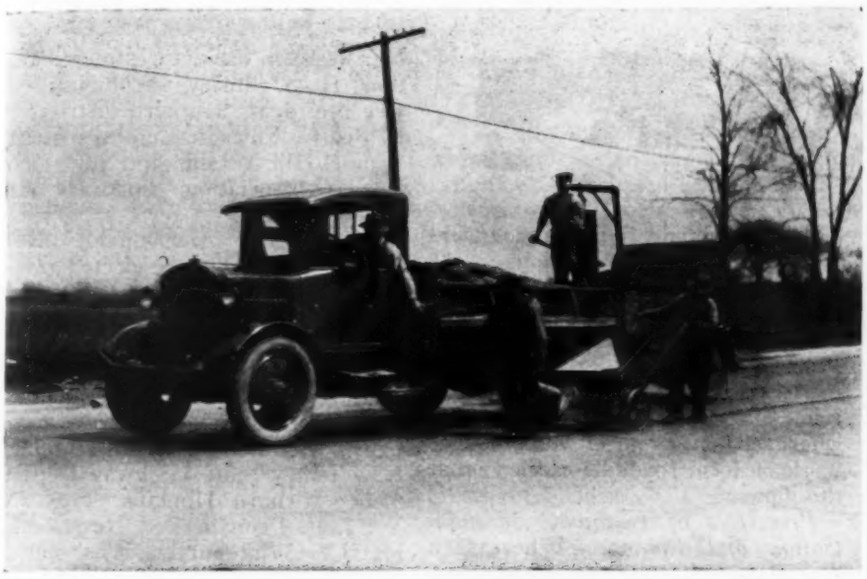
On the highways subject to co-operation, the counties were to furnish the snow removal equipment. While operating on the state highways under this plan, it was stipulated that this equipment was to be under the direction, control and jurisdiction of the state highway department acting through its division or district engineers. The counties were to be paid for the use of their equipment on a fixed hourly rental rate basis as worked, but in no case could the total amount to any county exceed the maximum allotment to that county under the $25.00 and $10.00 per mile schedule.

Reasons for Co-operative Plan.—There were two definite reasons for formulating the county co-operative plan. First, it was thought that this plan would encourage the counties to purchase snow removal equipment. Such equipment consists of two parts, the power unit and the snow plow. Snow plows are comparatively cheap. The power portion of the equipment is expensive, but most of the counties already have these in the form of tractors and trucks, which they use for construction and maintenance work during the summer months. If they will complete the unit by the purchase of the inexpensive plow, and rent the equipment to the state during the winter, the state will be relieved of large equipment investment which it is not justified in making and it will result in a decrease of total public expenditures. The second reason for the co-operative plan, was to in some degree at least place the burden and responsibility for meeting demands for a more comprehensive snow removal program upon and within the local community making such demands. While acceptance of this plan was, of course, optional with the counties, several took advantage of the program which resulted in additional miles of the state highway system being opened to travel during the winter months. And this was accomplished without an additional heavy equipment investment by the state.

While one year's experience with the county co-operative plan is hardly sufficient to judge definitely as to its merits, it is believed that the reasons for formulating the plan are being substantiated and justified.

The department will continue to send out road condition reports throughout the winter on the routes on which they will remove snow, but will not continue to report the condition of the roads on which it does not. Changes in condition between the regular weekly reports will also be sent out as they become available.

Applying Center Stripe in Oakland County, Mich.



A NOVEL center-striping outfit used on the concrete pavements of Oakland County, Mich., was described by E. J. Vaughan, maintenance engineer, in the May, 1930, issue of ROADS AND STREETS (p. 194). The photographs above show the outfit in action.

Slag from ¼ to ½ in. in size is applied by means of a special two-wheeled wheelbarrow. The material drops through an adjustable opening in the bottom of the barrow on to a belt which is driven by the revolution of the wheels. The device straddles the freshly poured strip and follows closely behind the man pouring. In this way the cover is deposited directly on the fresh tar; the adjustable opening allows the amount placed to be regulated.

The wheelbarrow is kept alongside of the trucks enough of the time for the shoveler on the truck to supply the barrow with fresh material without delaying the progress of the work. The wheelbarrow is kept on the heels of the man tarring to insure application of the cover material while the tar is hot. With proper coordination between the truck driver and the man pouring, the truck and kettle move ahead of the pouring pot as it becomes empty, and the man with the pot draws a fresh supply of tar while the equipment is in motion and again moves up alongside the truck. The only time this sequence of operations comes to a halt is when a fresh barrel of tar is placed in the kettle or the supply of slag in the truck is replenished. Four men, organized in this fashion, will tar better than a mile of center joint in an hour.

Financing Road Building in Sparsely Settled County in Virginia

By the selection of a definite mileage of roads and the capitalizations of the funds of Prince William County, Va., an economic program of road construction was evolved according to an extensive research study made by the American Road Builders' Association and the National County Roads Planning Commission.

Prince William County is an agricultural county of 15,000 population located about 30 miles from Washington, D. C. The study was made as an educational measure for the development of highways based on transportation needs and financial limitations.

It was understood that the funds provided for highway construction, and the methods of financing should not place too great a tax burden on the community, and satisfactory highways within a reasonable length of time must be provided.

Maintenance from the beginning of the program in 1930 and the "progressive plan" or "stage construction" of road building was recommended.

The finance plan is based on anticipated gasoline tax income, a county road tax levy applied to an increasing taxable value and the floating of five $100,000, 20-year serial bond issues, each with 5-year deferment periods. An increase in the present tax rate during the period beginning in 1935 and continuing through 1942, with a maximum increase of less than $0.20 per $100 valuation, was required.

Of the estimated 900 miles of roads in the county, a proposed primary county road system of 118 miles was designated and also 185 miles of secondary roads. This plan gives 1.17 miles of roads per square mile of area, and 80 per cent of the total area of the county is within a mile of an improved road. The primary roads were to be widened, drained, surfaced and relocated where desirable, while the secondary roads were to be maintained only.

It was estimated that 60 per cent of the county's farms were located on unimproved dirt roads.

The tax problem in the county was favorable when compared with that of adjoining counties; more than one-half of its tax revenue was expended for school purposes and less than one-third for road purposes.

As compared with the proposed finance plan, the "pay-as-you-go-plan" requires 14 years for completion; the rate of construction is slow, and losses due to automobile operating costs alone would more than pay for the total cost of the proposed road system.

The Road Builders' News

Resolutions Adopted at the A. R. B. A. Convention

The following resolutions presented by the Resolutions Committee at the St. Louis Convention of the American Road Builders' Association, were adopted:

Maintain Present State Revenues.—Whereas, the grave unemployment situation has led the president and the congress to make additional liberal appropriations for road building to be treated as an emergency fund to deviate this condition, and

Whereas, an earnest plea has been made to the states to cooperate to the fullest extent of their resources. Now, therefore, be it resolved,

That the state legislatures are requested to in no way decrease state funds, remove from state authority present incomes or adversely change the sources of revenue for state road building simply because the federal government has increased its fund for that purpose; the present state revenues for highways are all needed to permit the fullest cooperation with the federal government in this great task.

Motor Funds for Roads Only.—Whereas, the user of the highways, through the motor license fee and gasoline tax pays large revenues into the several state treasuries, and,

Whereas, these funds are contributed gladly in order that we may have an increasing mileage of improved highways. Now, therefore, be it resolved,

That we deplore the tendency in some states to use funds from these sources for other than the purposes originally intended. All motor vehicle funds, including personal property taxes on the motor vehicle, should be used solely for highway purposes.

Recommendations for Relief of Unemployment.—Resolved, that the American Road Builders' Association hereby recognize the excellent work done by the United States Government, the several states and many counties and municipalities, in formulating plans providing funds and carrying into effect, programs for unemployment relief, and it is the belief of this Association that much good has resulted from these operations.

It is recommended that this excellent work should be continued, and augmented.

To this end, it is urged that state, county and local governments make further appropriations wherever possible, and plan additional work and increased action for unemployment relief. It is recommended that wherever p r a c t i c a l, maintenance work on local roads be carried on at this time.

Principles of Highway Administration and Finance.—Whereas, a special committee of this Association, after many months of study and research, has reported to this convention a recommendation that all road financing and improvement should be carried on under a pre-conceived plan and budget, involving the interests of all classes of highways, and

Whereas, the "Principles of Highway Administration and Finance" recently approved and published by the American Association of State Highway Officials very closely coincides with the committee report of this Association and is concise and brief. Now, therefore, be it resolved,

That we commend the platform announced by the State Highway Officials as a guide in perfecting state legislation covering all phases of highway administration and finance.

It is recommended that this platform be printed in the proceedings of this Association as a part of this resolution.

New Officials of A.R.B.A.

Announcement was made at the St. Louis Convention of the American Road Builders' Association of the results of the letter ballots for officials of the Association.

William R. Smith, Meriden, Conn., contractor, was elected president. Otto Hess, Grand Rapids, Mich., was named president of the County Highway Officials' Division, and George B. Sowers, Cleveland, president of the City Officials' division.

Samuel Eckels, chief engineer Pennsylvania Department of Highways, was elected vice president, Northeastern district of the Association; H. G. Shirley, Richmond, Va., vice president, Southern district; S. F. Beatty, Chicago, Central district; Samuel Hill, Washington State Good Roads Association, honorary life president.

James H. MacDonald, New Haven, Conn., was re-elected treasurer. The board members elected were: Director of Streets and Sewers Robert B. Brooks of St. Louis; H. K. Bishop, Washington, D. C.; Paul L. Griffiths, vice president of the American Tar Products Company; A. Lee Grover, secretary, New Jersey State Highway Department; Richard Hopkins, Troy, N. Y.; J. E. Pennybacker, New York; H. C. Whitehurst, Washington, D. C.

Foreign Representatives at the St. Louis Convention

The nations of the world are learning anew from the United States to appreciate the importance of highways. Approximately 30 foreign countries sent their representatives to the St. Louis Convention and Road Show.

Heading the Pan-American Division of the organization and presiding on Pan-American Day was M. A. Coroalles, chief engineer of roads and bridges of Havana, Cuba. In this office he has directed the construction of the new Cuban Central Highway to be inaugurated Feb. 24. Constructed at a cost of $100,000,000, the road extends across Cuba for a distance of 703 miles. When the contract was let, it was the largest single road building project on record.

At the present time, Mexico is carrying out an ambitious road construction program, federally and by states, and boasts some of the best and most picturesque highways of America.

Ortiz Rubio, President of Mexico, sent to the convention his personal representative, Angel Casarin, Jr. Representing the department of Public Works and the Mexican National Highway Commission were Valentin Q. Gama and Ernesto Viadas. A. F. McKee, president, and Adolfo Blumenkron, vice-president, are from the Anahuan Machinery Co., of Mexico. Jose

Rivera, secretary of the Pan-American Division of the Association, attended from the southern republic.

At last year's convention, held in Atlantic City, every country in the Western Hemisphere was represented. Engineers were also in attendance from South Africa and New Zealand.

The Orient is cognizant of the tremendous part that road building plays in the progress and national unity of the country. China is manifesting a keen interest in engineering research as it pertains to highways, Yeh Ko-Liang, Chinese consul general at Chicago, a representative of the Honorable C. C. Wu, Chinese Minister to the United States, attended the convention.

Among the consuls who took an active part in the convention were Charles P. Muldoon, representing Brazil; Macedonio Romero, Colombia; Alberto G. Abreu, Cuba; J. N. Spangler, Ecuador; James A. Troy, Honduras; Dr. John J. Romero, Nicaragua; Miguel Angel Gabeldon, Venezuela. Horacio Pinochet Salgado, constructor of roads and bridges, came from Chile.

Other consuls who are interested in road building and its possibilities are Marc Sequin of Belgium; Nils Grant of Sweden; Hector M. E. Pasmezoglu of Greece; Paul Emile Cattin of Switzerland; Jose Alvarez of Spain; William Exton of Persia; John G. Borresen of Norway; Harry ter Braak of the Netherlands; Herbert L. Eastlick, representing the consul of Italy, and Reginald Milburn of Great Britain.

Who Is Eligible for Membership in A. R. B. A.

You are eligible for membership in the American Road Builders' Association if you are identified with the highway industry as a state, county or city official, engineer, contractor, manufacturer, distributor, material producer, publisher, educator or legislator.

Members are classified in the various divisions according to their specialized interests, including City, County, Engineers and Officials, Manufacturers, European, Pan-American, Contractors and Membership at Large. The various services offered members are available through the Washington headquarters throughout the year.

Membership in the Association has shown a continuous growth during the past few years and with the new bulletin and information services that have recently been inaugurated many new applications have been received.

Motor Freight Problems New in Convention Program

The subject of Interstate Commerce Commission control of motor freight was discussed at the opening session of the Motor Freight group of the Road Builders' Association. The subject was handled by J. W. Blood, secretary and general counsel for Southern Kansas State Lines Company, Wichita, Kans. Equitable truck taxation, state-controlled or unrestricted contract carriers, and economical handling of merchandise by truck also were discussed. J. N. Galvin, president of the Pennoyer Merchants' Dispatch, Chicago, presided.

At an afternoon session, Tuesday, the universal tariff and economics of trucking and truck costs occupied the attention of the delegates. A meeting of motor freight operators followed the afternoon session. The motor freight exhibit in exhibition building "B," included trucks, accessories and many other displays connected with this branch of transportation.

Increased Highway Construction Urged for Unemployment Relief

Resolutions for unemployment relief by public construction were adopted at the final business session of the American Road Builders' Association Convention.

The resolutions were introduced by a special Unemployment Relief Committee, headed by Thomas H. MacDonald, chief of the Bureau of Public Roads of the Department of Agriculture.

The resolutions urged increased highway construction to relieve unemployment, urged state legislatures not to decrease highway appropriations, and deplored the diversion by some states of gasoline taxes and motor vehicle license funds to other than road purposes. Such taxes, it was held, should be used solely on the highways.

Emergency appropriations by Congress for road building to alleviate unemployment were praised. Unemployment programs formulated by many states, counties and cities and by the Federal Government also were commended, and it was urged that wherever practical maintenance work be done on local roads.

Prominent Road Builders On Air During Convention

Each day during the A. R. B. A. Convention talks were broadcast from St. Louis radio stations KMOX, KWK and WIL by A. R. B. A. leaders and convention visitors.

This radio pragram followed on the heels of a most successful program of pre-convention radio publicity, in which road builders' talks were broadcast from ten of the leading radio stations of the nation by Association officials and leaders who discussed highway construction in benefit to unemployment, highway safety and the value of highway research.

The reaction to these talks has been gratifying and the St. Louis broadcasts will undoubtedly result in much wider dissemination of the knowledge of the work which the Association is doing in the highway fields.

The program for the week follows:

KMOX

Tuesday, 4:50 to 5:00 p. m.—Charles M. Upham, Engineer-Director.

Wednesday, 9:20 to 9:30 a. m.—Miss Louise Wynne.

Wednesday, 4:50 to 5:00 p. m.—Thomas H. MacDonald, Chief U. S. B. P. R.

Thursday, 4:50 to 5:00 p. m.—Col. C. E. Myers, president, City Officials' Division.

Friday, 4:50 to 5:00 p. m.—Stanley Abel, president, County Officials' Division.

WIL

Monday, 5:45 to 6 p. m.—(15 min.)—Norman M. Blaney, American Farm Bureau Federation, Chicago, Ill.

KWK

Monday, 6:10 to 6:15 p. m.—Senor M. A. Coroalles, chief engineer, Havana.

Tuesday, 6:10 to 6:15 p. m.—C. N. Conner, engineer-executive.

Wednesday, 6:10 to 6:15 p. m.—Samuel Hill, vice-president, Seattle, Wash.

Thursday, 6.10 to 6:15 p. m.—William R. Smith, Meriden, Conn., presidential nominee.

Friday, 6:10 to 6:15 p. m.—George B. Sowers, new president, City Officials' Division.

Opening Session.

Monday, 10:30 a. m., from Arena—President W. A. Van Duzer, Thomas H. McDonald, chief, U. S. Bureau Public Roads, Mayor Victor J. Miller.

New Equipment and Materials

New Light Duty Hand-Operated Snow Plow

A new hand-operated light duty snow plow designed to fill the gap between snow removal by trucks and the heavier type completely hydraulic tractor plow with wings, is a recent development of LaPlant-Choate Manufacturing Co., Cedar Rapids, Ia.

LaPlant-Choate Light Duty Snow Plow

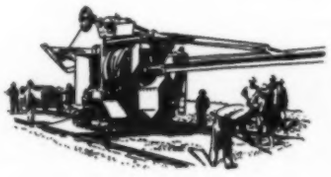
This plow has been designed with the scaffold mounted on the front of the tractor, very close to the radiator. A winding wheel is provided inside the tractor cab, giving the operator instant access to it, and allowing him to raise and lower the "V" nose without stopping or slowing down. The push point is located at the center of the track on the tractor, thus giving it the full benefit of the center pivot mounting. When equipped with wings two high speed chain hoists are used for raising and lowering the wings.

The plow can be operated with the greatest of ease. A worm gear has been provided so that the operator will not tire from raising and lowering the blade.

New 1½-1¾ Shovel

A new 1½-1¾-yd. shovel-dragline—crane-clamshell has been added to the line of the Bucyrus-Erie Co., South Milwaukee, Wis. The manufacturer offers the choice of Diesel, gasoline, or electric power, rope or chain crowd on the shovel, regular or special extra long and wide mountings for soft ground dragline work. Simplest possible convertibility saves time and money in changing over for other types of work. Bucyrus-Erie steels and unit steel construction, ball bearings on all

New 43-B Bucyrus-Erie Shovel

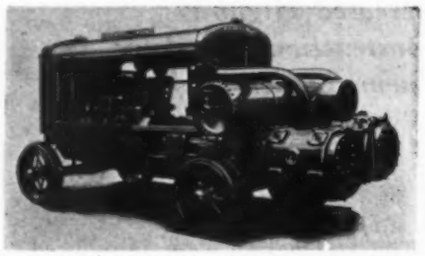


continuously running shafts, large oversize clutches, gears enclosed and running in oil, box girder boom, single-shaft-drive caterpillar mounting, are features of this machine.

A few other features of interest are: hoist clutches power set—all operating levers toggle in; smooth operating, oversize brakes with cooling fins; steered from operator's stand with cab in any position; double-operating chocking brakes on caterpillar mountings—controlled from operators seat; swing brake for operating on grades; three side vision for operator steel cab; inserted tooth dipper; only two bearings to a shaft; no binding of bearings; power dipper trip; self starter for engines; power boom hoist—self locking.

New 500-Cu. Ft. Portable Compressor

A new portable air compressor with a piston displacement of 500 cu. ft. per minute, has been announced by Ingersoll-Rand Co., 11 Broadway, New York. This



Type XL Portable Compressors of 500 Cu. Ft. Piston Displacement

unit is stated to follow a type of design that is distinctly different from that of smaller machines. It is designated the Type "XL."

The unit consists of a two-stage, horizontal compressor direct-connected to a 4-cylinder, 4-cycle Waukesha gasoline engine through spiral bevel reduction gears operating on ball bearings. Two complete water cooling systmes are provided—one for the compressor and one for the engine. Separate automatic lubricating systms also are used. A radiator-type intercooler cools the air between the stages of compression. Regulation is automatic.

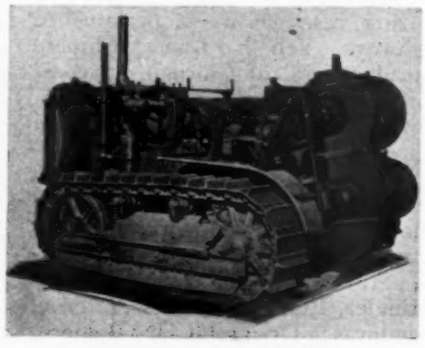
The complete unit, with gasoline tank and receiver, is mounted on a one-piece, cast-steel frame, equipped with rubber-tired steel wheels. The steel top is fitted with removable steel side covers arranged for locking.

The Type "XL" is intended for use on jobs which require a considerable amount of air.

Dragline Drum Unit on Tractor

A double drum dragline unit specially designed for attachment to a Caterpillar 60 tractor, is a recent product of the Pioneer Gravel Equipment Manufacturing Co., Minneapolis, Minn.

This unit is of extra heavy construction with large shafts, bearings and clutches.



Dragline Drum Unit Attachment

It is not a hoist, but is built for heavy dragline work and is equipped with Hyatt and Timken bearings in the drum unit. Journal brackets or bearing housing are machined to fit perfectly. Machined cut gears have a 4-in. face and large bronze bushings are used in the drums to avoid excessive wear in idling on the shafts.

The operator of the tractor can, from the operator's seat over the fender of the tractor, operate the dragline and 1¼-yd. dragline bucket.

New Elevating Grader

A new elevating grader with engine belt drive has been brought out by the Caterpillar Tractor Co., Peoria, Ill. The main shaft is driven direct from crankshaft of the engine which is mounted forward on frame of grader, through reducing gear set which is mounted on ball bearings. Gear set runs in oil. Front end of main shaft has self-aligning coupling. Rear of main shaft is mounted in self-aligning ball bearings. The engine develops 25 hp. at the carrier belt.

The grader weighs 15,375 lb. and has a rear tread of 8 ft. and a front tread of 6 ft. The wheel-base is 13 ft. and the length overall is 12 ft. The belt lengths are 33ft. and 39 ft.

Caterpillar 60 Elevating Grader

New Scales for Checking Truck Loads

As the initial move in a vigilant program of road protection, the state of Michigan has just installed a number of new highway scales and further installations are being planned. The scales were furnished by The Buffalo Scale Co., Buffalo, N. Y.

The scales are installed in pairs with about 10 in. clearance between them. The platforms are 6½ ft. square giving an overall double scale width of approximately 14 ft.—ample for the widest truck wheel bases. The construction of the scale is extremely heavy, allowing for a 15-ton loading at each corner of the platform; with a beam capacity of 60,000 lb. for each scale.

The general design of the scales closely follows that of the Buffalo single link suspension bearing motor truck scale and conforms strictly with the Bureau of Standards specifications for this class of scales. The scale bearings which utilize the Buffalo single link suspension principle, are unusually simple in design—having just six parts. According to reports, this simplicity, together with the long knife-edge bearings used in the main lever units, produces an extremely high sensitivity and accuracy.

The single links used at each corner of the scales are made of cast steel and are designed for line contact, making the platform bearings absolutely self-aligning. As a result, the platforms oscillate freely and return almost instantly to their original position, under all conditions, whether traffic is run over them, or when loads are on the platforms with brakes set on every or all the wheels of the vehicle.

Each scale has a recording beam graduated to 10 lb. minimum, and the weigh tickets are designed to show the weight of any wheel on any axle of a truck. Scale beams are erected in scale houses of unusually attractive architecture.

The scales were inspected and tested by the Michigan Department of Weights and Measures and were found correct at all loads.

Installation of Highway Scales

A Machine for Sanding Icy Streets

The accompanying illustration shows a device designed for the purpose of spreading sand or ground cinders on highways or city streets when they are rendered unsafe by ice or snow. The spreader is built as an independent unit so that it may be placed within the body of a truck and temporarily secured thereto or placed directly on the truck chassis. It consists of a steel hopper, screw conveyor, spinner disc, gasoline engine, drive gears, shafting and bearings, all mounted on channels as a single unit.

Good Roads Sand Spreader

The device is made with two speeds of the conveyor, so as to vary the quantity of sand delivered to the spinner, and consequently to the road surface. The amount of sand delivered to the road also depends on the speed at which the truck is being operated.

The spreader is built with a separate motor unit so that it is independent of the truck power and may readily be removed therefrom or changed to another truck without any changes except that of securing it to the body or chassis on which it is to be used.

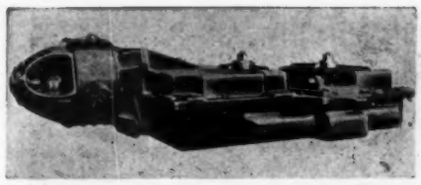
The spreader will normally throw the sand over a 9-ft. width of space. The body or bin of the machine will hold approixmately 6 cu. yd. of sand, and this, under normal conditions, will spread about three miles of sand 9 ft. wide.

The conveyor is a cast iron screw operating in a trough at the bottom of the bin. The conveyor delivers the sand to a chute at the rear which conveys it to the horizontal spinner from which it is thrown to the road. The control is by means of two clutches, giving a high and low speed to the screw by means of sprocket and chain drive.

This spreader is made by the Good Roads Machinery Co., Kennett Square, Penn.

New Shaker Conveyor Drive

Two of the outstanding features of a new shaker conveyor drive developed by the Conveyor Sales Co., Inc., New York, N. Y., illustrated herewith, are its simplicity and compactness. The overall dimensions are, height 24¾ in., width 84½ in., plus from 20⅞ to 35 5/6 in. for the motor, and length 44 in. The weight



New Shaker Conveyor Drive

installed is 6,400 lb. The mechanisms consists of a gear train and cross arm which convert the rotary motion of the motor into reciprocating motion of a cross head which is connected to the conveyor trough, with a minimum loss of energy.

Motors are rated 20 hp. and may be either DC or AC, permissible or open, as required. Automatic remote control with time limit acceleration and full protection against overload and under voltage is provided for the motor.

The construction of the drive is substantially as follows: A pinion on the motor drives a bevel ring gear, which is mounted on the same vertical shaft as a main driving pinion. This pinion in turn drives the main gears, which are also mounted on vertical shafts, one directly, and the other through an idler gear. The gears are made from heat treated cast steel, with stub cut teeth, and all shafts are mounted on Timken bearings, the mountings being such as to hold the various shafts in rigid alignment. Each main gear is provided with a crank, or wrist pin, which fits in a block sliding in a cross arm located under the gears, the cross arm being supported by circular ribs cast in the base and machined to the requisite smoothness. The cross arm in turn is pivoted on a cross head pin, set in the cross head, which slides in bronze guides set in the base. The cross head is pinned to the conveyor trough and both cross head and cross head pin are provided with bronze bushings. The whole bottom of the case serves as a reservoir for lubricant, and lubrication of the various bearings is provided for by an oil pump located in the case, and driven by an eccentric machined in the primary drive shaft. Thus a constant circulation of clean oil is assured.

Keystone 1931 Convertible Power Shovel

The new 1931 Model 17 of the Keystone Driller Co., Beaver Falls, Pa., is a completely flexible machine, full revolving and full crawler mounted, and equipped with all standard excavating buckets and attachments, namely skimmer, pullscoop, dipper or bank shovel, crane, clamshell, dragline bucket, magnet and pile driver. It weighs 28 tons complete with skimmer, pullscoop, clamshell, and 30 tons with the standard bank shovel.

Exceptional stability has been achieved by mounting the machine on very large roller path, 71 in. in diameter, with hold down shoes which tie the upper structure to the crawlers. This reduces the tendency to oscillation and makes it possible to accurately control and finish the grade with the skimmer bucket. The 21 ft. boom provides horizontal crowding movement of 14 ft. 9 in. so that it is stated the bucket can readily be filled in a 4 or 6 in. cut at one shot.

A full range of pullscoop buckets from 24 to 72 in. is available on this unit. Sizes

Model 17 Grading a Side Bank

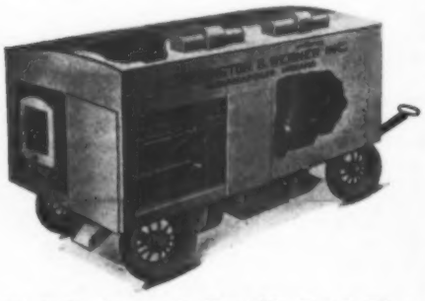
from 24 to 48 in. are standard. Three other size buckets are available, 54 in., 60 in. and 72 in.

The characteristic of the design is that the boom and digging buckets for skimmer-pullscoop operation have been made exceptionally light. The boom weighs about 2,500 lb. and the 1 yd. skimmer or 48 in. ditcher with attachments about the same.

The power unit is a Climax Blue Streak engine developing 81 hp. at 960 r.p.m. Traction speed is 75 f.p.m. Rotation speed is 5¼ r.p.m. The Model 17 is equipped with slipping friction drums making it possible to apply any desirable line speed suited to the conditions in which the bucket may be operated.

Asphalt Patching Plant

The accompanying illustration shows the portable automatic asphalt patch plant manufactured by Hetherington & Berner, 703 Kentucky Ave., Indianapolis, Ind. With this plant the cold material fed into the feed hopper is not again touched until it is discharged as finished material from mixer at end of plant. The plant has one hot and one cold elevator. The dryer drum is heated internally by fuel oil through combusion chamber. The tool heater is heated with oil burner, as is the asphalt kettle. The heat from the dryer and tool heater also assist in heating the asphalt kettle. Other features of the plant include: Storage bin for aggregate material; hot material bin with partitions; material can be screened to desired size as a rotary screen is provided above the hot storage bin; one main shaft from which all units are driven by means of cut gears and Diamond roller chain; plant equipped with roller bearings. The plant will mix black base or binder as well as topping material and it also can turn out cold mix material. It is a straight line plant on rigid trailer frame with rubber tired wheels. The shipping weight is 10,000 lb.



H & B Automatic Portable Patch Plant

A New Motor Scythe

An improved motor scythe has been announced by the Johnson Motor Co., Waukegan, Ill., which has taken over the licenses and patents for manufacture and selling of the motor scythe of the Rawls Manufacturing Co., Streator, Ill. The Johnson Co. engineers have made a number of improvements on the mower which will be known as the Johnson motor scythe.

The frame, formerly made of tube and angle iron has been replaced by flat stock of cantilever construction, making it sturdier and less subject to vibration. Vibration has been reduced to a minimum by replacing handle bars formerly welded to the frame with bars trunioned at axis of wheel. For guiding and carrying support, two spring yokes have been fastened to the frame.

The Pitman shaft and bracket have been redesigned to give adjustment for the drive belt. A vibration dampener has been placed on the shaft to compensate inertias of the cycle bar. The Pitman connecting rod is now of drop-forged, heat-treated steel, and is constructed heavier. The clevis pins are now of hardened ground steel.

Johnson Motor Scythe

The gas tank, constructed of ⅛ in. sheet steel, is welded to the frame. A drain plug has also been provided for emptying gas or any condensation in the bottom of the tank. The cutter bar head is now of drop-forged, heat-treated, steel.

The motor is of ½ hp., 2-cycle type. An outstanding improvement, however, has been a new type of starter which has been added. This starter throws the motor into operation with a pull of the handle. It is contained in a completely enclosed starter housing replacing the rope starter. An exhaust muffler has been attached to the motor.

The scythe is designed to be operated by one man, who pushes the one-wheeled frame while the motor operates the cutter bar.

New Steel Mules

The Marion Steel Body Co., Marion, O., manufacturers of the Marion line of dump body equipment has recently acquired control of The R. J. W. Mfg. Co., of Bucyrus, O., manufacturers of steel mules. The acquired company has been reorganized under the name of Marion Mules, Inc., and announces a new and improved product to be known as the Marion Mule.

New Marion Mule with Dual Pneumatic Tire Equipment and Bull-Dozer Attachment

For motive power either steel wheels, crawlers, or pneumatic tire equipment may be used and interchanged in the field without difficulty. The crawler tracks are Marion designed and built.

The power unit is a McCormick-Deering Model 10-20 industrial tractor unit. Transmission has four speeds forward, one reverse. The power unit is mounted complete in a heavily constructed chassis frame having 7 in. side channels. The front axle is of Marion design, full-floating and oscillating. The tractor drive axle does not carry the load. An auxiliary or dead axle in the rear is fixed to the chassis supporting the load and driving wheels. The tractor drive axle connects with the dead axle through a gear reduction of 5 to 3 thus increasing the power of the unit by fifty per cent.

The body is 4 cu. yd. capacity and may be increased to 5 cu. yd. with sideboards. The body is gravity operated and when in lowered position easily bull-dozes the load. Spark and throttle controls are located on steering wheel. A Ross heavy duty steering gear (20 to 1 ratio) is used. Brakes are both foot and hand operated.

All machine parts of the chassis are of alloy steel or forgings, reinforced and ribbed to stand heavy going. With crawler tracks the Marion Mule has a speed of 6 miles per hour; steel wheels at 9 miles per hour; and pneumatic tires at 12 miles per hour.

Improved Car Pulling Unit

An improved design of the Weller Capstan car puller has been brought out by the Webster and Weller Mfg. Co., 1856 N. Kostner Ave., Chicago.

Regularly built in three sizes to handle from one to six 80-ton cars, this electrically operated unit is self-contained, weatherproof, and designed to pull cars, trucks, etc. at any angle.

New Capstan Car Puller

1971 Aspirations..1871 Limitations

THE time to widen and straighten roads is before property values mount—not after. Road improvement will be less costly if done early.

Roads which accommodate only two lanes of traffic—roads with blind, sharp curves—do not fit the present or the future. For 1871, they were good enough; by 1971, they will lead only to deserted villages.

A good working understanding of the several ways improvement may be effected with Tarvia "Re-Tread" will encourage action where taxpayers are inclined to delay on the score of expense.

For Tarvia "Re-Tread" will provide dustless, rutless, easy-riding, ample-width roads at a cost that simplifies any financing problem. And a Tarvia "Re-Tread" road laid today for today's traffic will still be there as a solid foundation for further development when traffic hits the many-thousand-vehicles-a-day mark in 1941 or later.

The Barrett Company

New York	Chicago	Philadelphia
St. Louis	Minneapolis	Boston
Detroit	Cleveland	Birmingham
Buffalo	Columbus	Milwaukee
Providence	Syracuse	Cincinnati
Baltimore	Toledo	Rochester
Lebanon	Youngstown	Bethlehem
	Hartford	

In Canada:
THE BARRETT COMPANY, Ltd.
Montreal, Toronto, Winnipeg, Vancouver

Tarvia "RE-TREAD"

TRADE-MARK REG. U. S. PAT. OFF.

Do you mention ROADS AND STREETS when writing? Please do.

Distributor News

Schramm on the Air

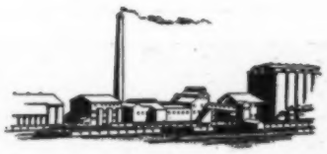
The title might refer to broadcasting, but in this instance it means aviating. 68 equipment distributors of national standing have entered as contestants in the 1931 Air Races as conducted by Schramm, Inc., of West Chester, Pa. They aren't chasing rainbows, these practical business man, but they are all hoping to find a pot of gold at the end of the race and 37 per cent of them will not be disappointed.

Mileage obtained by each dealer will determine the prize awards, and mileage is to be worked out on a basis of amount of business secured. Quota sheets have been distributed to all contestants so that scores may be kept and each pilot may know what position he is maintaining. Credit will be given on all sales of compressors, pneumatic tools, hose, steels and other accessories, but not on repair parts.

The race started officially January 1st and will continue for a period of four months, no credit being allowed for goods shipped after April 30th. Participants assembled at Schramm Fields the last of December to be enthusiastically greeted and receive a word of cheer from Mr. Henry Schramm.

Every detail has been thought of in order to carry out this contest as a true air race. Planes will move forward or be passed as sales of competing pilots pile up. Planes have been given the names of the cities in which the pilots are located.

During the four months that the race is being run, five prizes will be awarded each month to the first five fliers obtaining the greatest number of miles. These prizes will range in amounts from $50.00 to



$15.00. At the grand finish five grand prizes will be awarded ranging from $350 to the flier securing the greatest mileage for the entire race, to $55.00 for the one to finish fifth. A total of 25 prizes for the entire contest will give every entrant something to strive for.

When 68 equipment distributors enter into a contest of this kind keen competition may be expected, news notes from Schramm Field may be looked for soon.

Culvert Manufacturers Assn. Holds Convention

The Toncan Culvert Manufacturers' Association, which has its headquarters at Massillon, Ohio, recently held a convention and school at Canton. Addresses were made by J. T. Hay, manager of the association on "The Story of Rust and Corrosion," and also on the "Manufacturing and Processing of Toncan Iron." Other speakers included N. J. Clark, vice-president in charge of sales of the Republic Steel Corporation, L. D. Mercer, assistant manager of sales, sheet and tin plate division, Republic Steel; and Perry Van Horne of the Canton Culvert and Silo Company.

First hand information as to the manufacture of toncan iron was presented to the visitors by way of trips through the various plants of the Republic Steel Corporation. The rust-resisting qualities of this product give it a wide variety of uses, such as, corrugated culverts, locomotive boiler tubes, pipe lines, stay bolts, railroad cars, tank plates, roofing, etc.

Timken Will Exhibit at Southwest Road Show

Visitors at the Southwest Road Show and School to be held at Wichita, Kansas, the latter part of February, will find an interesting display of the Timken Roller Bearing Company featured in Booth No. 128. The exhibit will be a display to show the capacity of tapered roller bearings for carrying heavy thrust loads, as well as reducing friction.

The display consists of a steel mill type bearing, weighing about 500 pounds, mounted at one end of a vertical shaft. The shaft is supported at the other end by a small bearing, which carries the whole suspended weight. The shaft is driven by a fractional horsepower electric motor, using a fish line as a belt.

Representatives of the Timken Company at the Show will include: L. M. Klinedinst, vice-president, Canton, Ohio; R. P. Profitt, District Manager of Industrial Sales, St. Louis; V. Steele, Industrial Representative, St. Louis; G. D. Thewlis, District Manager of Industrial Sales, Chicago; H. W. Trump, Industrial Sales Engineer, Chicago; and G. W. Curtis, District Manager of Industrial Sales, Milwaukee, Wis.

Toncan Culvert Manufacturers in Convention

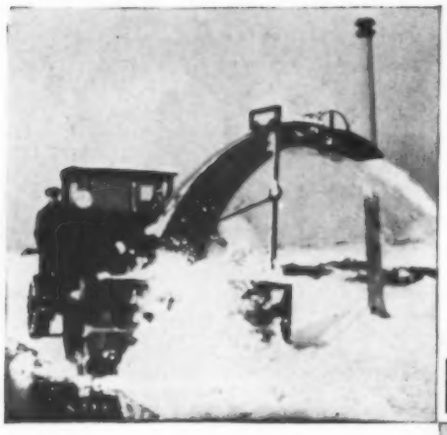
From left to right, front row: L. E. Leslie; C. C. Daley; Frank E. Weller; J. L. Cresap; John A. Fritchley, Treasurer; Perry Van Horne; Firman L. Carswell; Mary C. Brickner; J. T. Hay, Manager; L. M. Berry, Advertising Manager; L. J. Moore; George W. Adams; Wallace W. Cunningham and G. A. Bryant

Second Row: R. M. Haynes; George T. Selby; J. Carl Whiteman; Dorsey Allison; J. E. Simpson; George Ashworth; Beal Shaw; Leonard Meyers; S. A. Bradshaw; T. G. Roper; R. A. Clapp; A. A. Nelson; Jim Curtiss

Third Row: G. P. Wyland; H. L. Hunt; J. B. Daly; J. F. Manahan; Frank Manary; A. C. Culver; Earl P. Grames and C. J. Bailey

Fourth Row: C. P. McDonald; E. E. Nichols; G. A. Branson; Matt Powers; Geo. G. Allen; Geo. P. Deebach; J. E. McMillan; Chas. T. Coleson; Frank M. Turner; Otto W. Schmidt; E. P. Hefner; E. R. Johnson and W. P. Haynes

Fifth Row: Charles W. Greene; J. P. Griffin; Carl Conney; R. C. Kelly; W. H. Hampton and Frank DeCorps, Jr.



WET SNOW

WILL YOUR EQUIPMENT HANDLE IT ?

SNOGO

SNOGO is guaranteed to handle wet snow of any consistency • • • It's record to date is snow containing over 50% moisture • • • in fresh light snow or water-soaked slush its capacity remains the same and is measured in tons per hour.

THE SNOGO CATALOG TELLS
THE COMPLETE STORY—WRITE FOR A COPY

KLAUER MFG. CO. DUBUQUE, IOWA

Speeder Machinery Celebrates Its Most Successful Year

The Speeder Machinery Corporation, of Cedar Rapids, Iowa, were hosts to their salesmen and dealers the week of January 5th during their annual Sales Conference. The delegations this year far exceeded any previous conference and the interest and enthusiasm of all concerned was most gratifying to the factory. Dealers representing almost every state and many Canadian Provinces were in attendance. Many interesting sessions were held. These for the most part were in the form of conferences but two forceful speakers from outside the organization also appeared on the program.

Mr. O. W. Crowley, Executive Secretary of the Associated General Contractors of America, Central Branch, spoke on the subject, "Cooperation Between Your Salesmen and the Local Secretaries of the A. G. C." and gave a very forceful talk on what the A. G. C. is trying to do and how the equipment salesman may help them in their program with consequent benefit to all concerned. Mr. Alden Perrin, of the Gillette Publishing Co., spoke on the subject, "Using Advertising as a Selling Help."

Mr. Deal, Sales Manager, is authority for the statement that the Speeder Company has just wound up the most successful year in their history. More machines were built and shipped than in any previous year. Stocks were completely cleaned up on January first. There was not a single machine left in the hands of a dealer anywhere in the United States or Canada and only one completed machine remained at the factory. Not a single repossessed machine was in the hands of either the factory or any dealer. The Production Department has been running two shifts per day for several weeks and there is by far the largest amount of spring business already signed up that the company has ever had at one time.

A great amount of interest has been manifest in the new Speeder Whirlwind, a ⅜ yard, full swing machine, patterned very largely after the already well known ½ yard Speeder. The big ¼ yard machine also came in for much attention and some rather startling demonstrations were staged with the big brother of the Speeders.

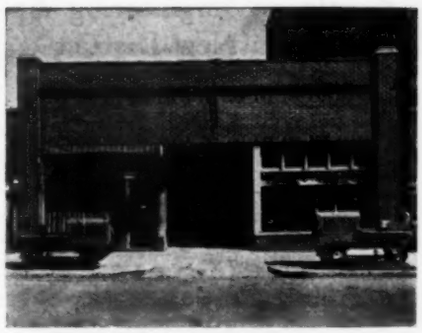
No description of the conference would be complete without mention of the enthusiasm and optimism which permeates the entire Speeder organization. This was especially refreshing at this particular time when practically all industry has been in more or less of a slump for a year past. Every dealer and every salesman seemed to think that 1931 would be even a bigger and better year than 1930.

McFarland to Represent Link-Belt in Missouri

Link-Belt Company of Chicago, announces the appointment of the McFarland Tractor & Equipment Company, St. Joseph, Missouri, as their agent for the sale of their products in Atchison and Doniphan counties in Kansas and in 17 counties in northwestern Missouri.

Kirk McFarland, president McFarland Tractor & Equipment Company

Although this company is but two years old the personnel are men who have been connected with the highway and construction industry in their territory for so many years it is but necessary to mention their names to identify the firm. Kirk McFarland, the president, is assisted by A. W. Hall and Ed H. Wolter. They will specialize in Link-Belt cranes, shovels and draglines.



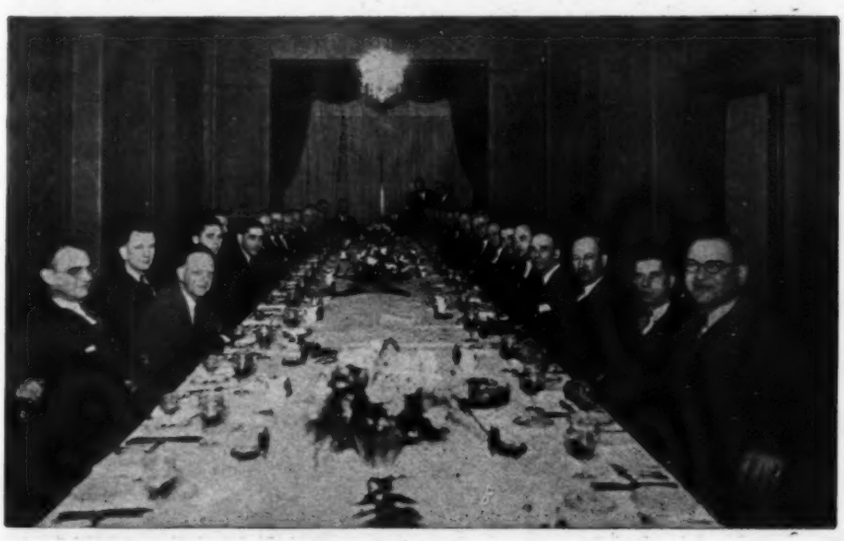
Salesroom of McFarland Company, located at 221 South Third St.

LeTourneau Makes Manufacturing Connection in East

R. G. LeTourneau, Inc., Stockton, California, manufacturers and designers of a line of heavy grading equipment and the Davenport Locomotive and Manufacturing Corporation of Davenport, Iowa, recently concluded an arrangement whereby the Iowa firm will manufacture and sell the LeTourneau line of equipment in the eastern and middle-western states under the name of Davenport-LeTourneau Equipment.

Several officials of the Davenport organization are said to have visited the LeTourneau plant and are convinced of the possibilities for the line in the east, if manufacture could be arranged to avoid high freight rates. At the Road Show, recently held in St. Louis, the company exhibited a sheeps-foot roller, 7-yd. scraper, 12-yd. dump wagon, 10-ft. bulldozer, heavy rooter and 2 power control units. One of the sheeps-foot rollers was recently shipped to South Africa.

It is stated that Mr. LeTourneau will spend some time at Davenport during the time the western equipment is getting its start in the eastern plant.



Speeder Machinery Company Plays Host to Dealers and Salesmen. The Annual Banquet Was Held at the Montrose Hotel

New Hercules Laboratories Near Completion

The new experimental laboratories, costing more than a half million dollars, which will house the research facilities of the Hercules Powder Company at Wilmington, Delaware, are nearing completion. The main laboratory building and a number of smaller units have been finished and are awaiting installation of equipment.

The laboratories are being moved from Kenvil, New Jersey, and will permit a closer contact between the company's research department and its main office. It is stated by company officials that formal opening of the laboratories will take place within the next few months.

It is stated by Russell H. Dunham, president, that much of the company's growth has been founded on the results of chemical research resulting in the development of more widespread industrial uses for nitrocellulose, cotton linter pulp, naval stores, and explosives and it is planned to continue to carry on such research work to insure future growth.

Northwest Engineering Appoints New District Manager

The appointment is announced of Chester Coulter, as district manager in the Pacific Northwest for the Northwest Engineering Company. Mr. Coulter will work with Northwest agents in the states of Washington, Oregon, Idaho, Western Montana and the Canadian province of British Columbia, promoting the sale of shovels, cranes, skimmer scoops and other products manufactured by Northwest.

The new district manager has had ten years of experience in the sale of this class of products, having been associated with the Erie Steam Shovel Company and later with the Bucyrus-Erie following its consolidation. He served as Southern district manager for the Erie Company and also as assistant district sales manager for Bucyrus-Erie.

Mr. Coulter is a graduate of the University of Washington, his native state, and is familiar with Pacific Coast conditions. His office will be located with the Pacific Hoist & Derrick Company, 818 First Avenue, South, Seattle, Washington.

Mussens, Limited, Will Represent Good Roads Machinery in Canada

Recent announcement has been made of the fact that Mussens, Limited, with headquarters at Montreal, will hereafter represent the Good Roads Machinery Company throughout the Dominion. In addition to the Montreal offices, this company maintains large distributing warehouses in Toronto, Winnipeg and Vancouver, and is known from coast to coast.

The distributing company will handle a complete line of Good Roads products, including Champion and Climax crushing equipment, such as crushers, elevators, screens, conveyors, washing and transmission equipment for the installation of plants for producing sand and gravel, graders, drags, distributors, spreaders, and a line of high speed snow plows for motor trucks and busses.

C. A. Ward Joins American Gas Accumulator Co.

C. A. Ward, formerly sales manager of the Essco Manufacturing Company of Peoria, Illinois, has recently joined the American Gas Accumulator Company of Elizabeth, New Jersey. This company manufacturers traffic devices and airport lighting equipment and Mr. Ward will take charge of territory including a group of central western states.

Headquarters for the mid-western territory will be maintained at 127 North Dearborn Street, Chicago.

Cleveland Manufacturer Will Head 1931 Air Races

L. W. Greve, active head of the Cleveland Pneumatic Tool Company, Champion Machine & Forging Company and the Cleveland Rock Drill Company is president of the National Air Races, Inc., the non-profit group of business men who have arranged to underwrite and sponsor the annual national airplane races in Cleveland for the next ten years. A formal agreement, signed by Mr. Greve as president of National Air Races, Inc., president of the Cleveland chapter of the National Aeronautic Association and chairman of the aviation committee of the Chamber of Commerce and by Senator Hiram Bingham as president of the National Aeronautic Association, gave the races to Cleveland for the next five years with an option for the following ten years.

Mr. Greve has served as an officer in the American Drop Forging Institute and the Compressed Air Society, and during the war was chairman of the Pneumatic Tool Committee of War Industries.

Edward R. Bacon Co. Adds Products of Two Western Manufacturers to Line

The Edward R. Bacon Company, San Francisco, has recently been appointed distributor for Schramm compressors in central and northern California and western Nevada. The company reports considerable activity in this line, having sold six compressors to a single contractor for pipe line work shortly after the firm took over the agency for it.

FWD trucks will also be handled by this distributor for the territory in central and northern California. This line is manufactured by the Four Wheel Drive Auto Company of Clintonville, Wis.

Announcement

Hugh W. Skidmore and Gene Abson, directors of that old firm of consulting and inspecting engineers which has been known for the past twenty years as the Chicago Paving Laboratory, announce the adoption of the title Chicago Testing Laboratory, Inc., as a more inclusive name for describing the field of their activities.

This firm does not wish to abandon the old name which has come to mean much to them for so long a time, so the new title is an addition rather than a substitution and old friends will hereafter find them listed as Chicago Testing Laboratory, Inc., and affiliated Chicago Paving Laboratory, Inc. The change is in name only as the same personnel, equipment and location continues to serve.

The consultation services offered by this organization covers: Investigation; reports; specifications; design; physical and chemical testing; research and laboratory, plant and job inspection of pavements, structures and works.

Announcement

M. A. Lippman, Assoc. M. Am. Soc. C. E., and former instructor in civil engineering at the Polytechnic Institute of Brooklyn, New York, has been appointed representative of the Kentucky Rock Asphalt Company in New York, New Jersey and New England. Mr. Lippman, who is well known among highway engineers and highway officials in this territory has established offices at 11 West 42nd Street, New York City.

"World's Largest Truck Display"

WGN, WLS, WLB are all well known letters for what are known as the World's Greatest Newspaper, the World's Largest Store and the World's Largest Building, and now we have WLTD, the World's Largest Truck Display, which is to be found at the Dodge plant in Detroit.

This exhibit under the direction of Dodge Brothers Corporation, a division of the Chrysler Corporation is announced as a permanent one to adequately represent the most complete line of trucks ever offered by "Dodge or any other truck manufacturer." It comprises scores of trucks, representing the multitude of models that are available to truck users in all lines of business.

The display, which covers an area of 54,890 square feet of floor space, includes in addition to the trucks, passenger cars, busses and taxicabs. It is open each week day from 9:00 A. M. to 5:00 P. M.

Dodge Truck Display

This Blaw-Knox Bucket handled 275,368 tons

without sheave bearing replacement

11-18-30

The Blaw-Knox Company,
526 Union Building,
Cleveland, Ohio

Gentlemen:

We purchased from you on May 22nd, 1928, one three-quarter yard Clamshell bucket. This bucket has been in constant use since that date rehandling Port Crescent Lake Sand from stock piles to railroad cars and trucks. This sand is extremely fine and highly abrasive.

We have handled during that time a total of 275,368 net tons, and commend the use of this bucket to anyone desiring to handle similar materials. No replacement has ever been made of sheave bearings.

We also have a Blaw-Knox Digging bucket at one of our pits at Port Crescent, Michigan, where it is giving excellent satisfaction.

Very truly yours,
SAND PRODUCTS CORP.

(Signed) A. N. FARMER
Treasurer

THE experience of the Sand Products Corporation is common to all users of Blaw-Knox Ball Bearing Buckets because the vital parts in Blaw-Knox buckets, which represent nearly 80% of all bucket replacement, are protected against wear.

The sealed ball-bearing sheaves keep abrasive materials out—maintain lubrication against neglect, assure easy opening and closing—minimize strains and stresses.

The scientifically tempered scoop lips wear very slowly.

These and other improved features of Blaw-Knox Ball Bearing Buckets are described and illustrated in new catalog 1234 just issued. Ask our nearest office for your copy now.

BLAW-KNOX COMPANY 2003 Farmers Bank Bldg. - Pittsburgh, Pa.

New York Chicago Cleveland Detroit Buffalo Birmingham Philadelphia Baltimore Boston

EXPORT DIVISION: Blaw-Knox International Corporation, Canadian Pacific Building, New York

London, England, New Oxford House, Hart St., Holborn, W. C. I.—Paris, France, 1 Rue de Clichy—Milan, Italy, 6 via S. Agnese
6 Dusseldorf, Germany, 17 Bismarckstrasse.

BLAW-KNOX

BLAW-KNOX

Service Exchange

for Manufacturers or Distributors

Editor's Note.—From time to time we receive letters from distributors wishing to be put in touch with manufacturers of certain lines of equipment, or from manufacturers seeking representatives of their products. Items of this kind will be published and names and addresses furnished interested persons upon request.

New Lines Wanted

Equipment distributor covering New Jersey, Delaware and eastern half of Pennsylvania in position to handle line of gasoline pumps, diaphragm, centrifugal, etc., 2 to 35 hp.

Wanted line of picks, sledges and crow bars, spades, shovels and similar implements by New Jersey broker, with warehouse facilities, contacting New York and New Jersey jobbers.

Distributor located in Virginia wishes to make connection to represent manufacturer of manganese crushing plates and jaw rock crushers.

Export manager for American manufacturer of road graders is in a position to handle an additional line of non-competing construction machinery, for manufacturer seeking foreign representation.

Manufacturer's representative located in New York City, now handling pumping machinery, would like to take on two or three additional lines serving the same field as his present account.

Distributor located in Portland desires line of stationary diesel engines, from 75 to 150 hp. to serve western trade for driving rock crushers and industrial plants.

Manufacturer's representative with 25 years sales experience, conversant with all types of pumps and their field, desires agency for either New York or export territory, or both.

Michigan distributor would like to add two or three good lines to serve territory in southwestern part of state.

New York state distributor would like to add two or three lines to serve his territory.

Warehouse facilities for serving Pittsburgh territory. Would like to secure line of portable and stationary conveyors.

Wanted agency for any type of building specialties or contractors' machinery except mixers. Twenty years experience. Familiar with all types of contractors' machinery. Could act as sales manager for Atlantic Coast line with dealers.

Machinery distributor, established in Porto Rico and Santo Domingo, would be pleased to make arrangements to take on new lines in these territories.

Manufacturer's representative, covering Massachusetts, Rhode Island and southern New Hampshire, would like to secure line of speed reducers and gears.

Wanted for Buffalo, Niagara Frontier and Western New York territory a good power and heating boiler account.

Equipment distributor in Pacific Northwest desires line of road building equipment, structural building equipment, dump bodies and truck hoists.

Diesel engine account, road building material and equipment line, and industrial equipment and materials seeking representation in south wanted by Florida distributor. Large warehouse facilities.

Distributor of building specialties covering a territory of 100 mile radius from Chicago is equipped to represent additional lines.

A Michigan distributor, with many years' experience, representing at this time prominent manufacturers of pumping machinery, offers the services of an established representative to manufacturers needing increased facilities in this region.

Distributor covering Wisconsin and Illinois territory wishes to add to present lines. Thoroughly familiar with bituminous materials and equipment for handling.

Wanted line of street markers or other traffic equipment on exclusive basis by distributor covering New Jersey and New York territory.

Representative in Northwest desires to handle, on commission basis, line of road building and maintenance machinery, revolving scrapers, tractors, rotary snow plows and V push plows.

Wanted exclusive sales rights for state of Mississippi for line of automatic or self-loading wheeled scraper.

▼

Representatives Wanted

Manufacturer of air compressors and contractors' tools has number of desirable territories open. Full co-operation will be extended to distributors.

Manufacturer of patented luminous highway danger signs and signals is interested in securing aggressive representation in various parts of this country and Canada.

Manufacturer of complete line of construction equipment, mixers, saw rigs, plaster and mortar mixers and pumps has an open territory in the state of Maine and is looking for an aggressive distributor to represent him there.

One of the leading manufacturers of surveying instruments in the United States is seeking responsible agents in all sections of the country. Instruments are nationally advertised in all leading engineering journals.

Distributors wanted to represent improved type of snow fence. Good territory in various parts of country.

Southwest and Middlewest distributors wanted by manufacturer of metal lath, corner beads, channels and reinforcing mesh.

Long established and well-known manufacturer of industrial locomotives wishes to make contacts with qualified distributors. Locomotive line includes steam, gasoline, gas-electric and oil-electric. Supported by national trade journal advertising.

Manufacturer of metal tie and spacer wishes to establish distributing points throughout the country.

Eastern manufacturer of grade-rippers, scrapers and road hones has desirable territory open for distributors.

Manufacturer of asphalt ingredient, adaptable for use in the road or industrial field, is seeking representatives for desirable territory in various parts of the country.

California territory available for distributor wishing paving expansion joint account.

Good, unassigned territory available for distributors and manufacturer's representatives to handle paving expansion joint line.

Attractive territory open in states south and west of Chicago by manufacturer of cut to length, easily erected standardized steel highway bridges, for spans up to and including 40 ft. Product sells to highway commissioners and superintendents.

Manufacturer of Transverse Testing Machines desires to build up distribution organization in this country and abroad.

Several desirable states open. Wanted distributing organizations covering entire states by manufacturer of mechanical spreader.

Territory open in several states for representatives to handle grade-rippers, scrapers and plows.